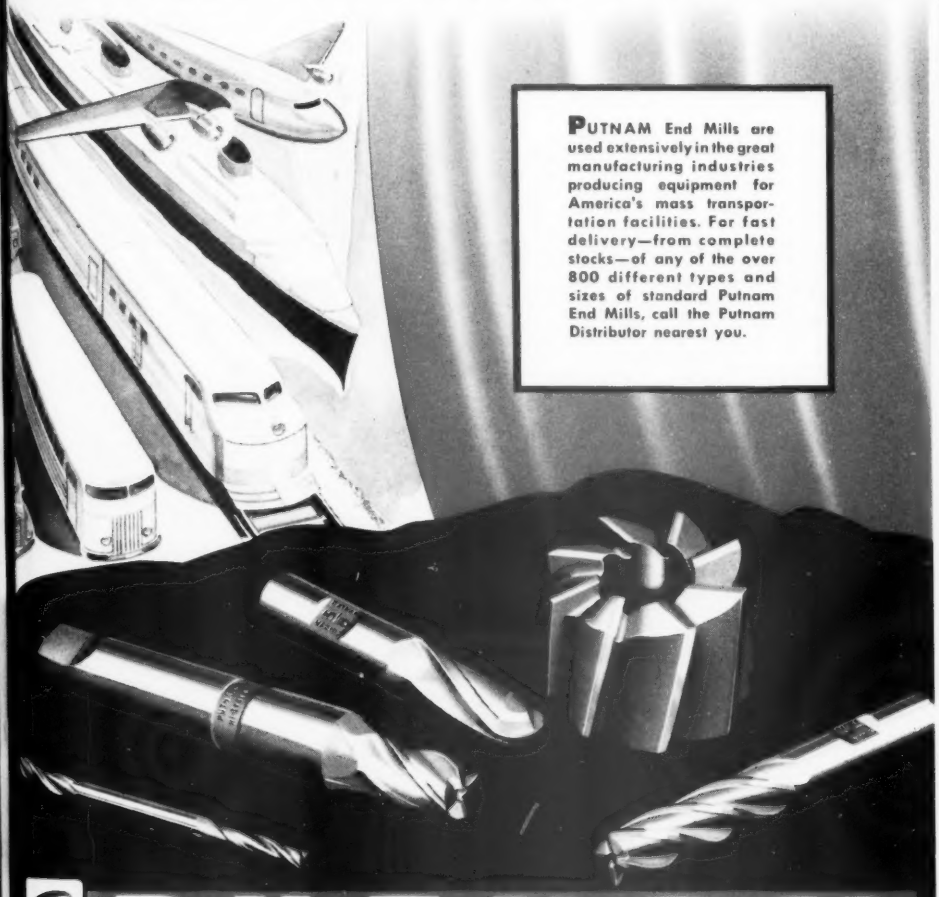
MARCH • 1947

TOOL & DIE JOURNAL

DESIGN, MANUFACTURE AND USE OF PRODUCTION TOOLING

END MILLS FOR MODERN PRODUCTION



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HARDSTEEL *vs.* Cast Alloy Cutting Tools

TEST LOG

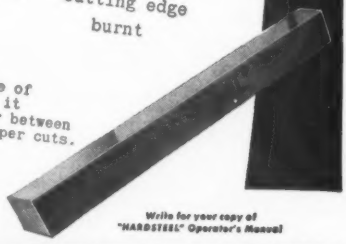
Material. Hardened and drawn High Manganese. High Carbon tool steel
Tensile Strength 176,000 lbs. per square inch
Rockwell Hardness C-38 Average
Depth of Cut .100"
Feed Per Revolution: .0035"
Surface Feet Per Minute: 130

RESULTS

	Average Total Time to Failure	Tool End Wear
"Hardsteel"	20 minutes	None
Competitor "A"	11 minutes	.008"
Competitor "B"	10 minutes	.007"
Competitor "C"	8 minutes	cutting edge burnt

Conclusion:

The inherent heat resistance of "HARDSTEEL" tool bits makes it possible to hold size longer between grinds, and take faster, deeper cuts.



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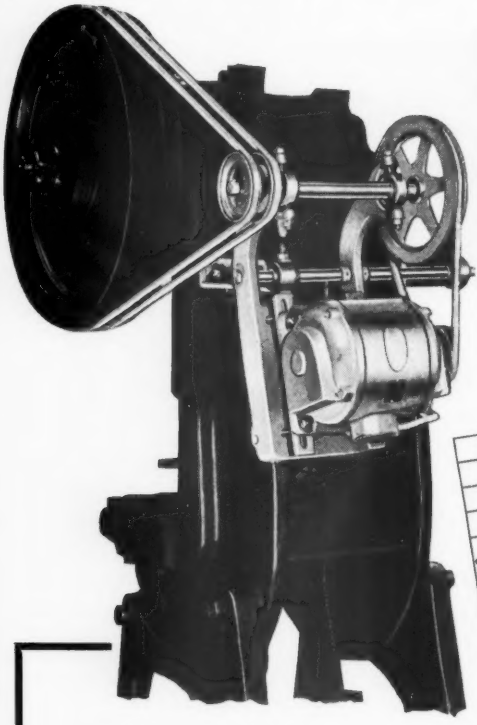

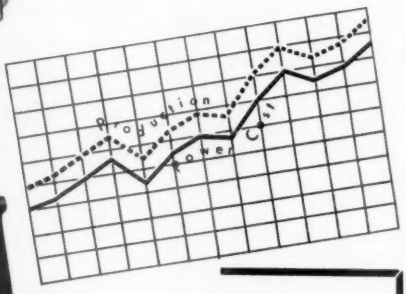

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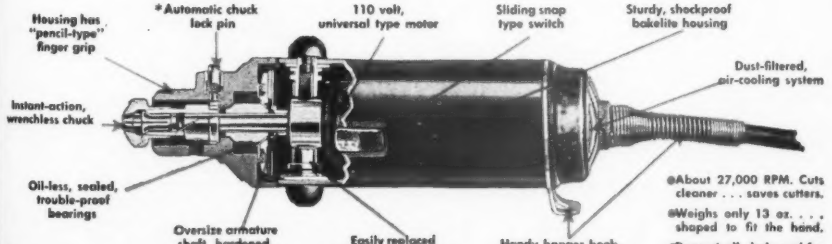
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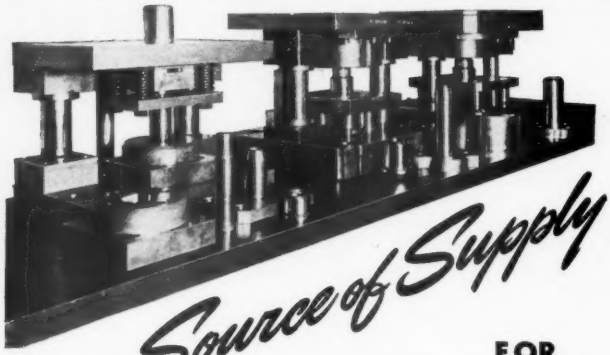

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ROCKER ARM Strongly ribbed and braced, made of high-tensile semi-steel; carries extra large hardened and ground alloy steel crank block in its highly finished sliding surface.

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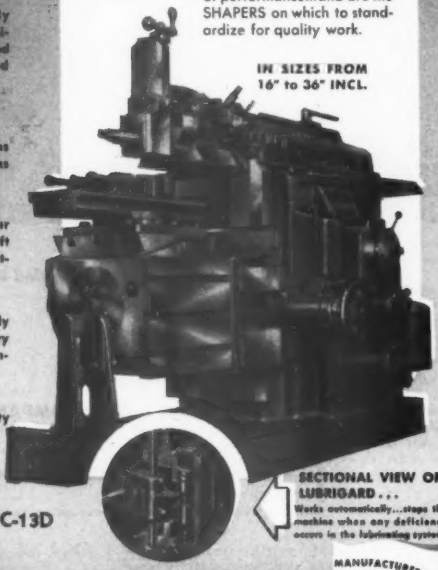

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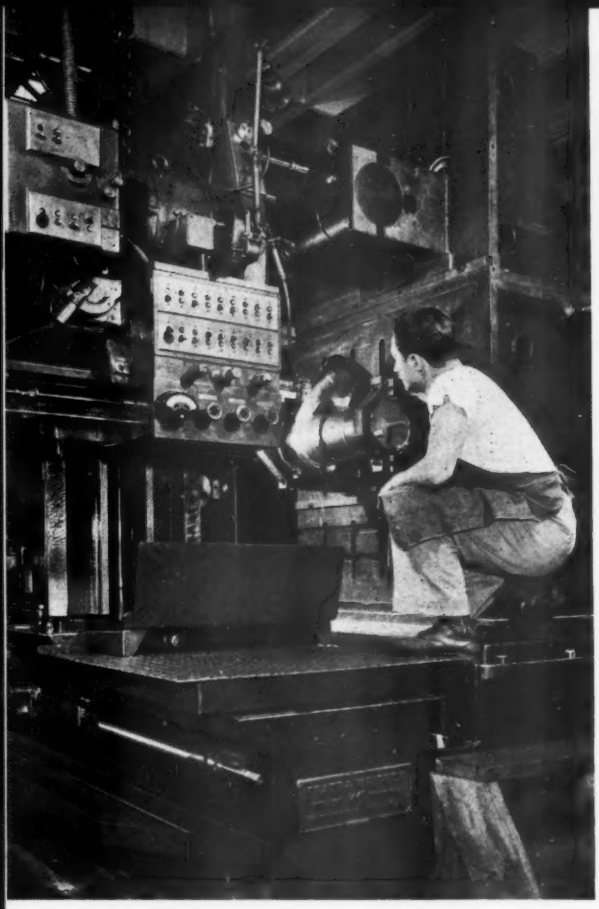

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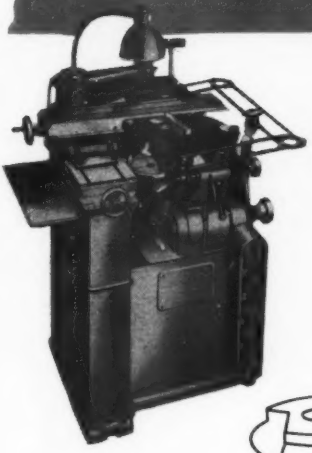

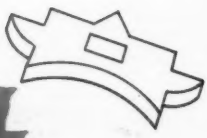

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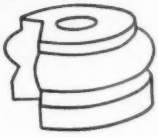

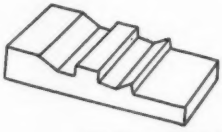

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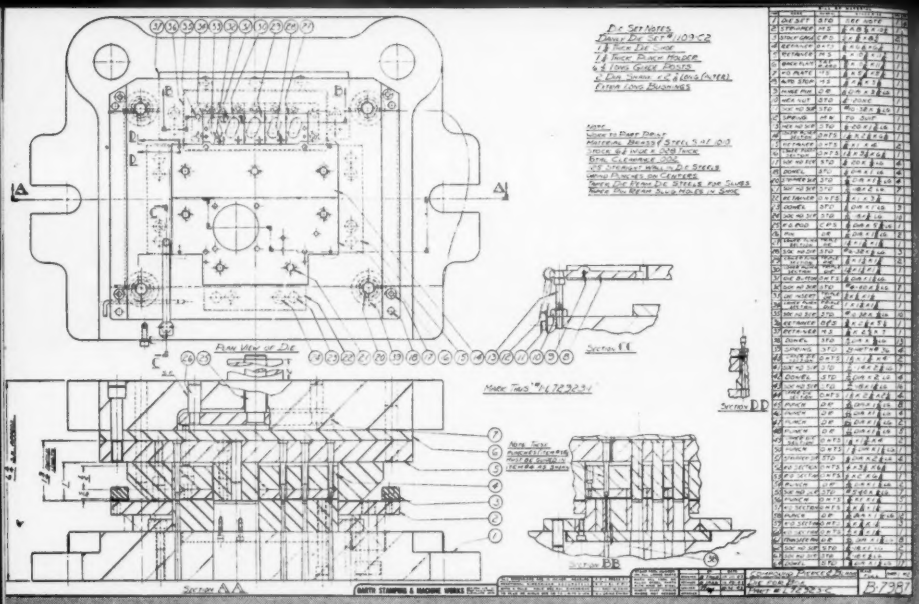

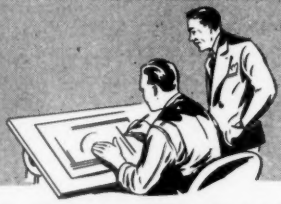

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Material—Aluminum alloy.

Machine—Gorton Tracer Controlled 3-U Pantograph with special fixtures.

Operation—Mill 30 impeller blades in machined aluminum alloy blank with completely automatic feed and indexing.

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Remarks—Shape of cut determined by motortrol master which drives the tracing stylus. Feed of cutter governed by special cam interlocked with indexing arrangement.

1¾" O.D.

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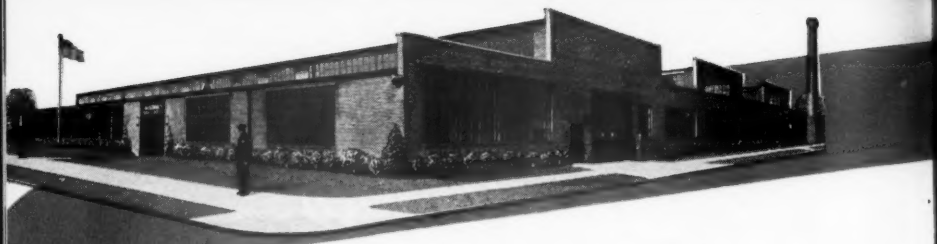

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As a result, many manufacturers now have a greatly increased respect for specialization as it applies to their own industries.

Forced, by necessity, to rely upon specialists for essential production tools, they saw demonstrated the value of this service. And now in peacetime, they rely upon these highly skilled organizations for engineering and production of their important tool equipment.

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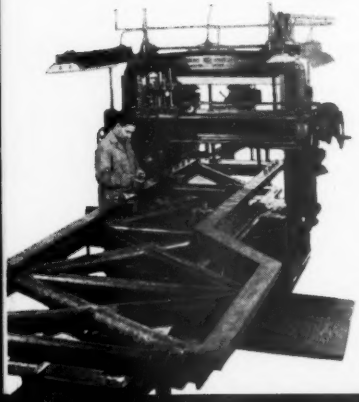

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made possible by a large and continuing volume of business, include corps of skilled machine operators and tool builders—batteries of specialized tool building machinery and engineering personnel and equipment second to none.

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To Make Your Own Tools?

Tool requirements vary with times and seasons but demand prompt and competent attention when they do arise. Capable tool designers and builders are difficult to find. They can't be hired and fired at will but must be kept on payrolls. So, too, highly specialized and expensive machinery must be maintained constantly, regardless of varying requirements.

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The New Enlarged Third Edition by Gordon B. Thayer

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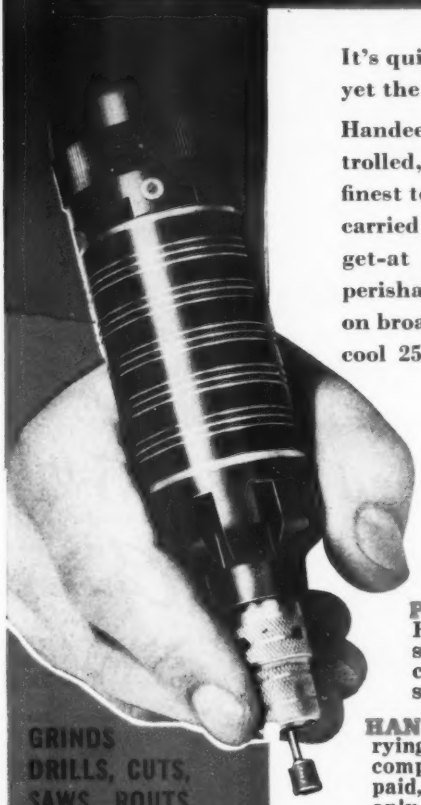

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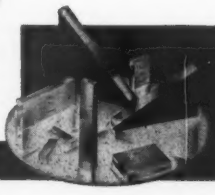

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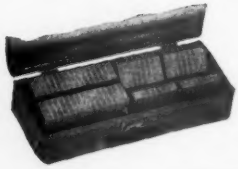

This universal set consists of two parallels 1" x 1¾" x 3¾", and two V-blocks 1¾" x 2⅜" x 1⅞". This set has been especially designed for holding various types of work that cannot be placed directly on the magnetic chuck. Complete in Hardwood Case.

$14.50 SET

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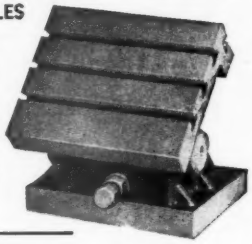
FOR MACHINING AND GRINDING ANGLES



These Angle Plates are made of the best grade of gray iron, machined and ground true with the holes, all steel parts are hardened and ground.

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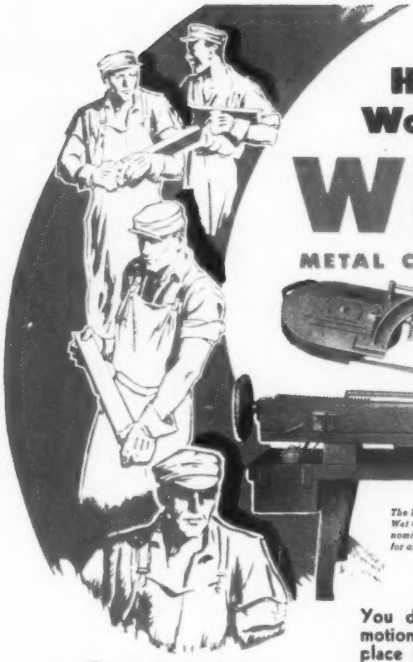

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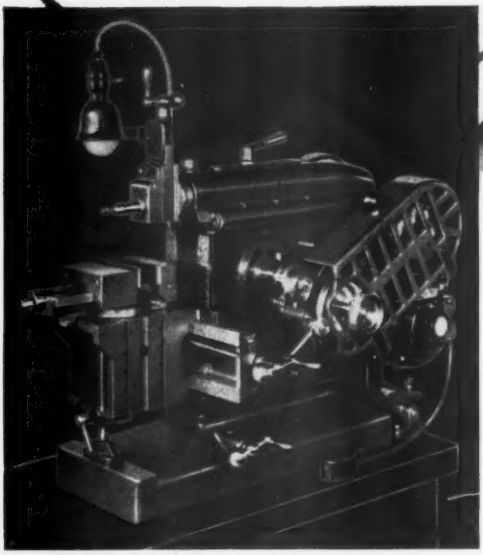

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with swivel vise and wrenches, including 4 step V-pulley, adjustable countershaft, motor driven pulleys, 2 V-belts, adjustable lamp and switch. Belt guards and motor, extra. Net weight 175 lbs., shipping weight 225 lbs.

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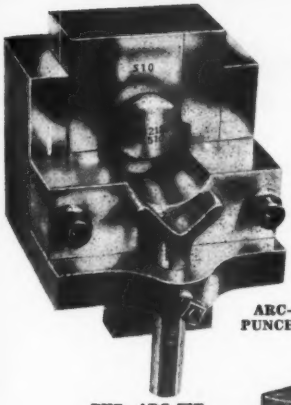

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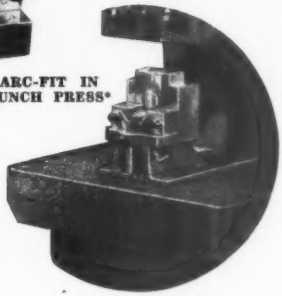

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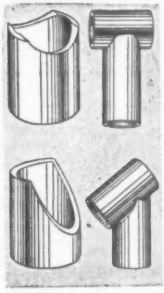

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Notable features of ARC-FIT include:

- A sturdy precision tool
- For any size pipe or tube
- Usable with hand or power press
- No rejects even with unskilled operators
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- Quick punch and die interchanges in one housing
- Shears from inside of the pipe or tube
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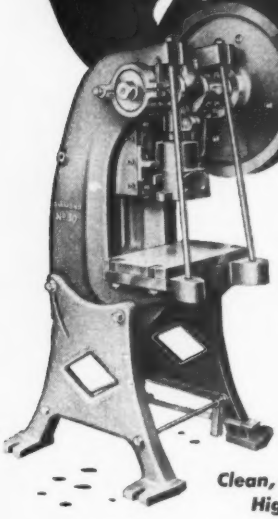

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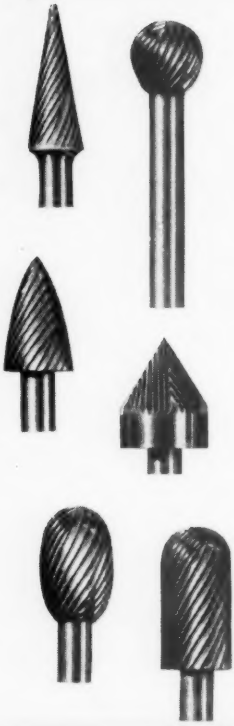

• Danly Kool-Kote Rotary files cut at speeds and on hardened die steel where no other similar tools will perform. The Kool-Koted process lends an amazing toughness to the outer surface which gives these tools up to 500% longer life.

A special flute ground continuing across the top of the radius leaves no ragged tooth ends to scratch or mar.

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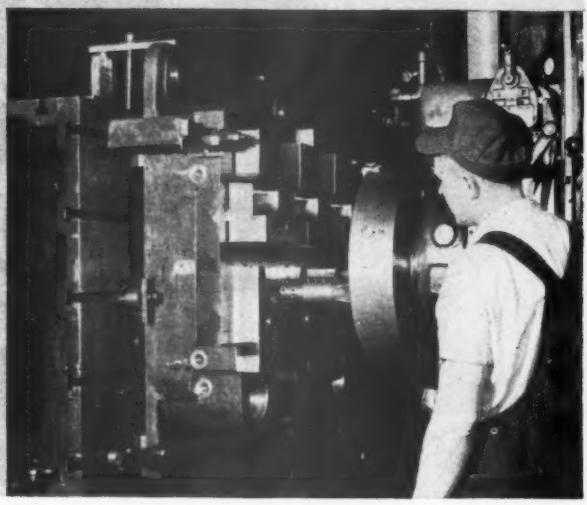
Now Danly Special Die Sets

with any additional machining required



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Time is saved by this service as work on dies and on the die set can be done at the same time. It permits the die shop or tool room to devote their equipment and man hours to the making of dies. The problem of the handling of big sets, for which the die shop or tool room are not generally equipped to do economically, is also solved by this service.

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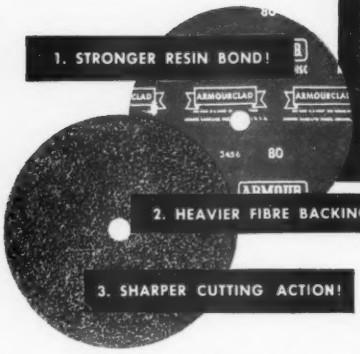
MACHINED TO YOUR SPECIFICATIONS



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Now... Faster, more productive metalworking with the New ARMOURCLAD RESIN FIBRE DISC!

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The new Armourclad Resin Fibre Disc cuts *faster longer* because its special resin bond gives better grain adhesion—greater resistance to heat and humidity.

Better for all disc operations, the new Armourclad Resin Fibre Disc is *especially good* for severe grinding jobs.

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Grinding is our business. We have the equipment (see list at right) and the skilled manpower for *any* kind of grinding . . .

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42—Sets of Gage Blocks (81 blocks per set) providing one set for each Grinder Hand and Gagemaker

Remainder of our shop is equally well equipped and provides facilities for supplying all of your requirements on tools, gages, special machines or precision components.

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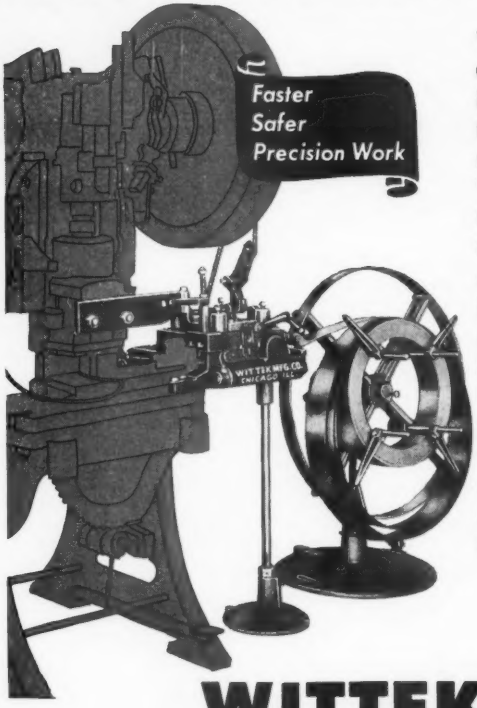
MICHIGAN 7230

Planning Peacetime Production Using Coiled Strip Stock?

Equip with
WITTEK
Automatic Roll Feeds and Reel Stands



Wittek Roll Feeds are being used extensively by war plants in their large volume production of high quality metal stampings. The flexibility of Wittek Roll Feeds will assist these plants in their peacetime conversion through their adaptability to various jobs. Keen competition will demand the utilization of equipment to its point of highest efficiency. If your postwar plans include punch press production of parts from coiled strip stock—investigate now the many possibilities of Wittek Roll Feeds and Reel Stands.

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Automatic
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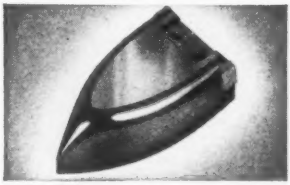
of tool and die WELDING ELECTRODES

. . . can help you save 4 ways

Typical repair to forging die with Eureka "Drawalloy" Electrodes.



Oil hardening Tool-Steel punch Eureka Welded with Oil-hardening Electrodes.

The use of Eureka Tool and Die Welding Electrodes can help you save man-hours, conserve valuable tools and dies and minimize production delays in 4 ways: 1. Repairing dies. 2. Composite fabrication. 3. Correcting design. 4. Rectifying errors.

Save tons of forging dies and untold man-hours by eliminating resinking operations! Eureka "Drawalloy" Welding Electrodes do the trick by rebuilding to original dimensions the contours of forging dies that have heat-checked or spalled!

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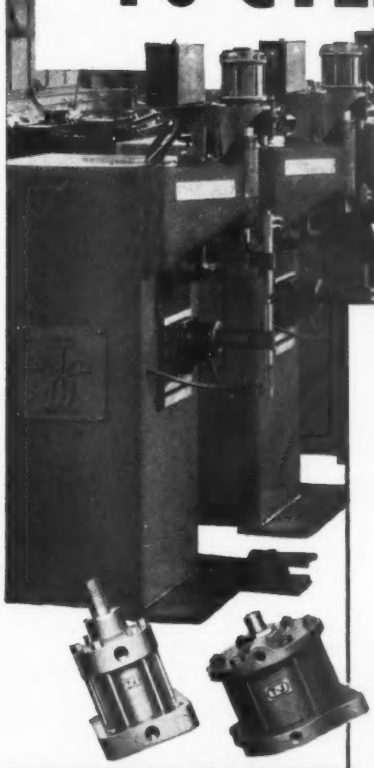

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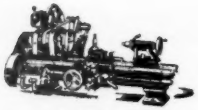
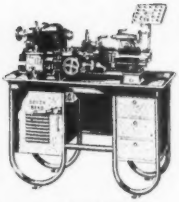
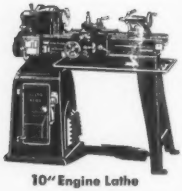


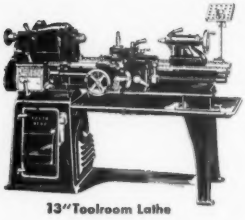
9" Bench Lathe



10" Bench Lathe



10" Engine Lathe



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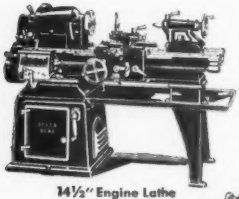
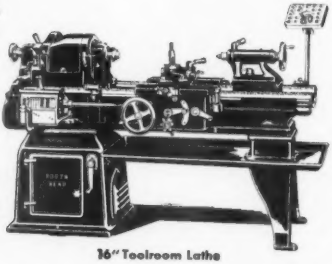


14½" Engine Lathe



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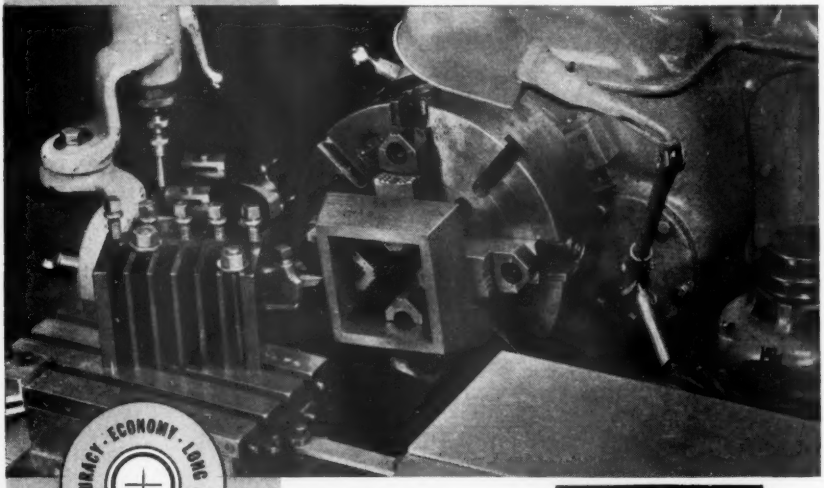
If you're doing die work—or any contour turning in metal—you owe it to yourself to investigate the Shapemaster. Like more facts? We'll be glad to oblige. Just write to The Monarch Machine Tool Company, Sidney, Ohio.



For complete factual and pictorial information on how the famous Monarch Shapemaster can save you time and money in the precision production (or reproduction) of dies, write for your copy of Bulletin 2501.

RACINE HYDRAULICS

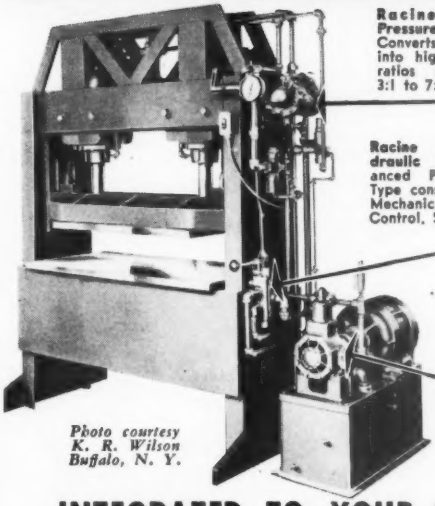
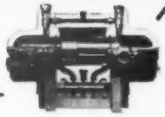


Photo courtesy K. R. Wilson Buffalo, N. Y.

Racine Hydraulic Pressure Booster — Converts low pressures into high pressures in ratios ranging from 3:1 to 7:1.



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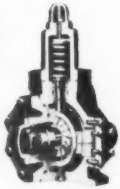

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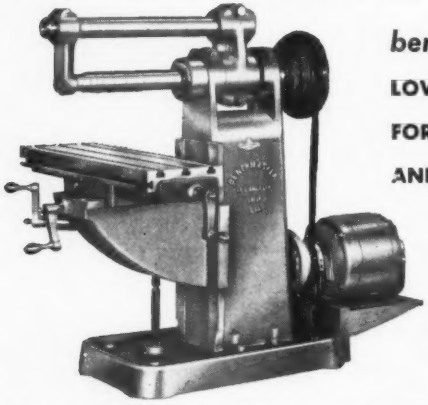

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"MO-CUT"	Braeburn Alloy Steel Corporation
"STAR MAX"	Carpenter Steel Company
"MOLITE M-1"	Columbia Tool Steel Company
"REX T-MO"	Crucible Steel Company of America
"DI-MOL"	Henry Disston & Sons, Inc.
"HI-MO"	Firth-Sterling Steel Company
"REX T-MO"	Halcomb Steel Company
"MOGUL"	Jessop Steel Company
"TATMO"	Latrobe Electric Steel Company
"MIDMAX"	The Midvale Company
"S. T. M."	Simonds Saw & Steel Company
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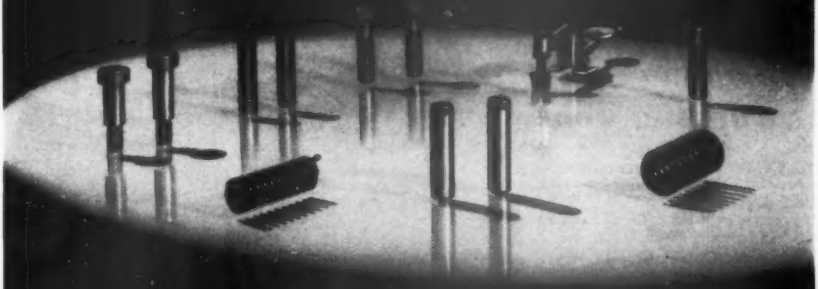

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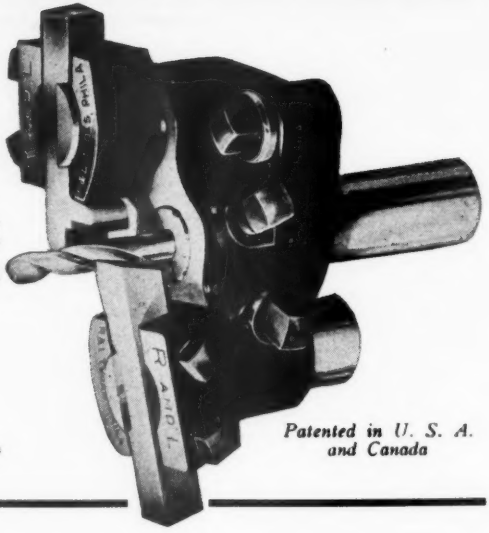
One R and L Combination Turning Tool, the only combination right hand and left hand tool on the market, actually does the work of 14 tools.

You can use an R and L for all these right hand or left hand applications:

- Roller Box Tool
- Centering and Facing Tool
- Knee Tool
- Pointing Tool
- Back Rest
- Floating Drill Holder
- Balanced Turning Tool

The change from right to left or vice versa takes only ten seconds.



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- **Essential parts ground to extreme accuracy affording perfect alignment at any point of adjustment.**
- **Back Rests, or burnishers, have almost diamond hard surfaces eliminating metal pick-up and marring of work surface.**
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- **Usable either for roughing or finishing; extra heavy cuts possible because thrust is always in direct line with Back Rest.**
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All these and many other features are shown by photographs and drawings in descriptive booklet mailed without cost or obligation. The booklet illustrates the tool set-up for various operations, and indicates speed and simplicity of its adaptation to various jobs. Prices and full specifications of many available sizes are included. Write for your copy today.

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"I'VE NEVER SEEN A MACHINE ADAPTABLE TO SO MANY DIFFERENT OPERATIONS"

"ALL OUR OPERATORS WANT TO USE THE MULTIPRESS"

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"THEY CERTAINLY WITHSTAND HARD USE. OURS OPERATE 24 HOURS A DAY - MOTORS ARE NEVER TURNED OFF!"

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"DOES *TWICE* THE WORK IN *HALF* THE FLOOR SPACE!"

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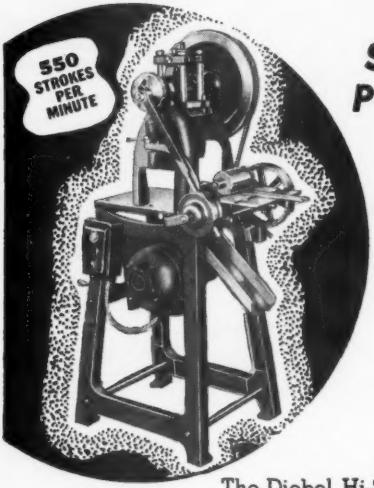

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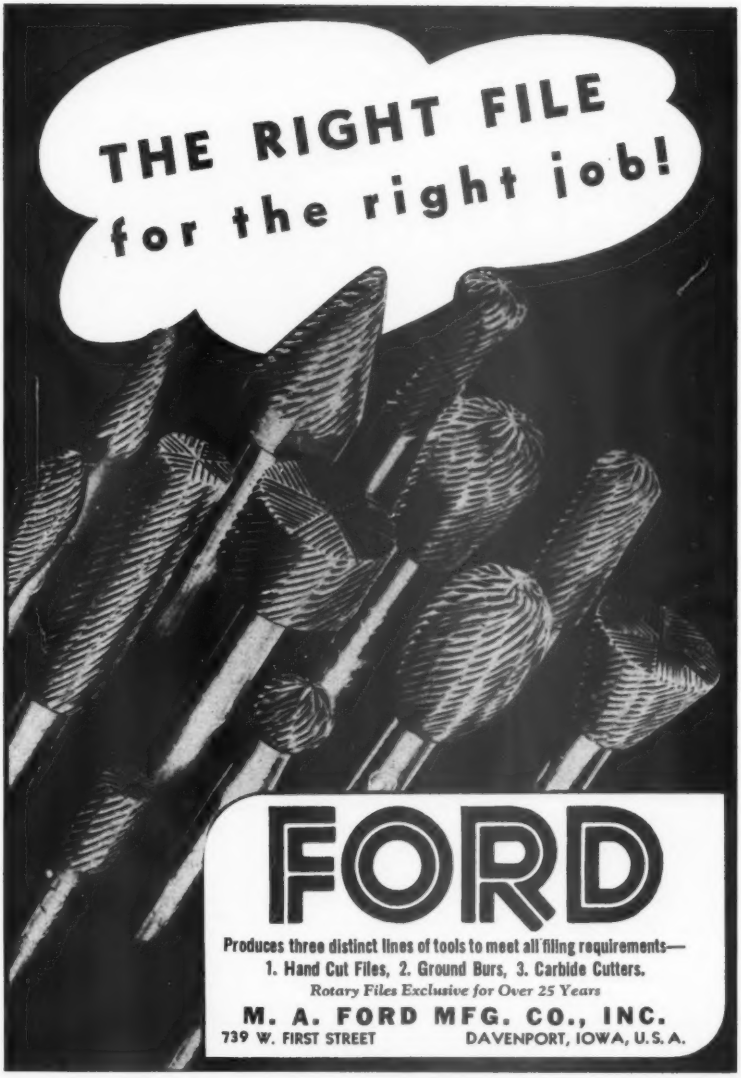
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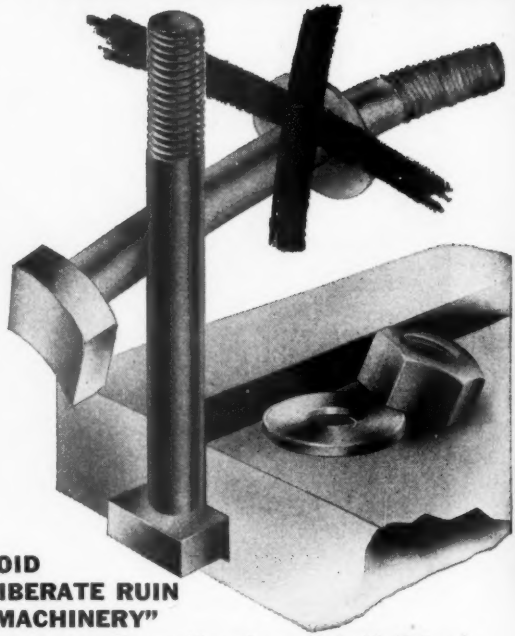

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Above is from a letter to Tool Engineer, January 1946.

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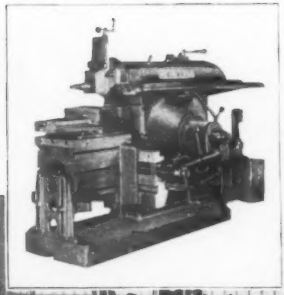

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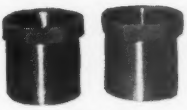

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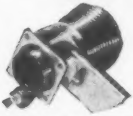

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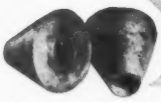

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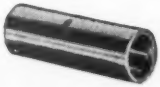

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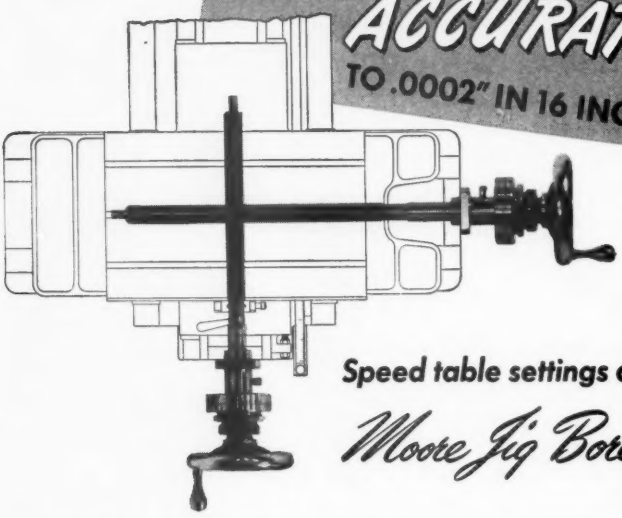

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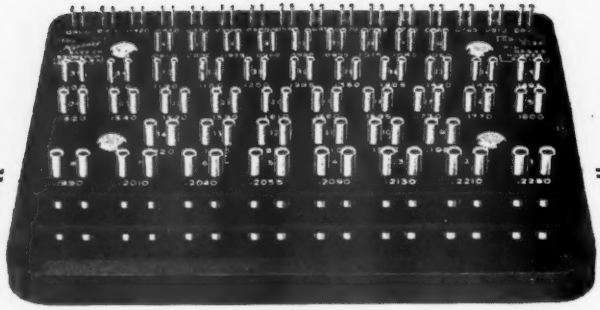

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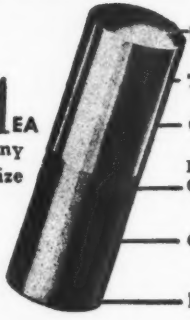

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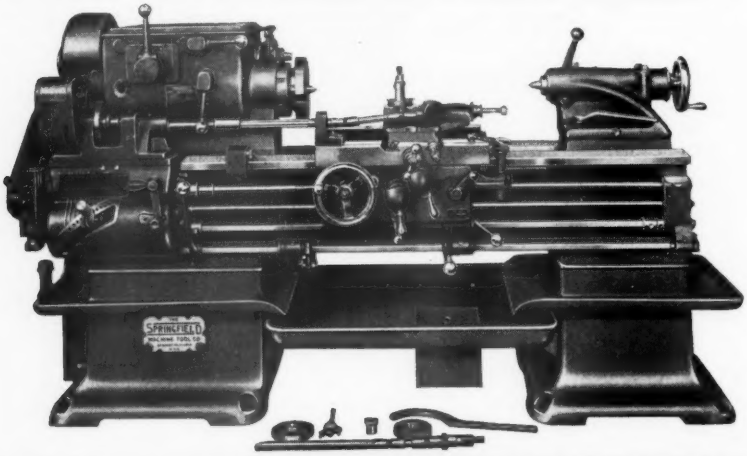
ASK US FOR *YOUR* COPY OF BULLETIN 162 which illustrates and describes the features of the Springfield Precision Tool Room Lathe and gives detailed specifications.



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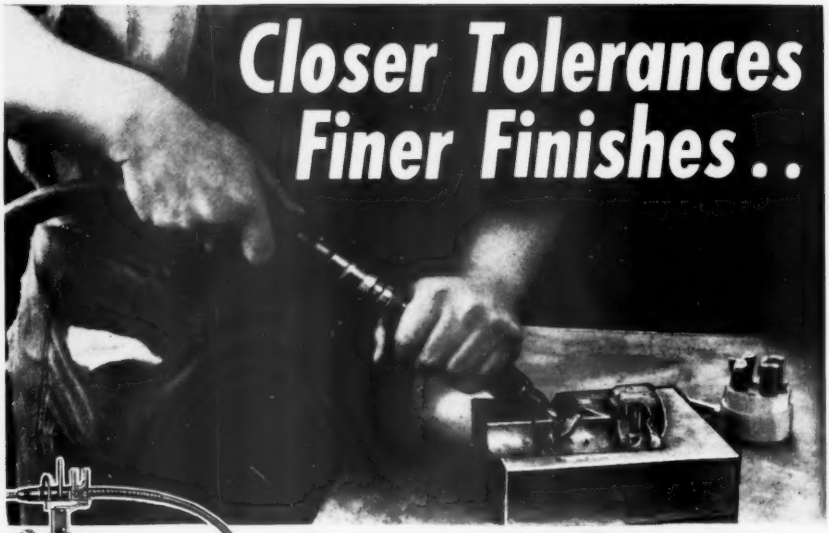

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transfer machine tooling

Although the development and application of transfer machines goes back appreciably prewar, the current accelerated interest in the technique is due to the outstanding success of transfer machining in war production.

The transfer machine has a multiplicity of automatically-cycled functions built-in, such as drilling, boring, reaming, tapping, milling and grinding. Work-holding fixtures or carriages travel on bed ways and automatically carry the work from one operation station to the next, and accurately locate and clamp and dwell at each station for the specific tooling operation of that station. The end result is a constantly flowing production line comparable to a constantly moving assembly line.

The economic justification, in spite of the additional and more intricate tooling that is part and parcel of the transfer machining picture, is the lessened direct labor chargeable against each workpiece, i.e., the lifting, pushing, positioning, lever flipping, unloading, etc., performed manually. That this is an appreciable factor is evidenced by one postwar application of transfer machining to an automotive, straight-eight cylinder block; and it becomes more significant when we realize that even by the least efficient prewar methods there would be relatively little *direct* labor, literally, on a workpiece as heavy and bulky as an eight cylinder block, because the operator's manual exertion would be considerably assisted by such mechanical aids as chain hoists, push tables, air cylinders, trunnion fixtures, etc., all intended to lessen his manual effort or direct labor.

As the economy effected by the transfer machining of large workpieces proves out, how about smaller workpieces wherein direct labor is truly direct labor? We refer to workpieces ranging in magnitude from camera chassis and carburetor bodies through outboard motor crankcases to gear housings; anything that does not exceed in bulk and weight the capacity of an operator's one or two hands.

When an operator lifts such a workpiece from a tote pan and positions it in a fixture, his entire wage for the seconds or minutes duration of those motions is chargeable against that workpiece; and the more holes, threads, flats, recesses and counterbores that are specified, the greater the direct labor in percentage of finished value. Direct labor on small workpieces can easily represent a higher percentage of finished value than on large work.

The transfer machine with its special tooling is a highly specialized tooling "package" and, for the work we have pictured, its design and construction is a natural for the Contract Tool and Die Industry.

Certainly the design and construction of a production tool that condenses or confines a variety of metal-removing operations by a series of fixed, independently driven spindles to a four- and/or five-foot path along hardened and ground vees or around a precision bearing center is no formidable undertaking for those skills that can produce mating tool parts with light-tight fits; build intricate dies and molds with duplicate cavities and complicated inserts; duplicate forming tool profiles to a couple "tenths"; to say nothing of turning out a twelve or fifteen station progressive die that "transfer presses" flat stock into a precision, three-dimensional part of difficult profile and complicated perforation pattern.

From progressive dies to transfer tooling is a low-hurdle but logical challenge for TOOL & DIE JOURNAL readers, the designers and builders of industry's special production machines and production tooling.

E. Willard Pennington

editor

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One Setup For Roughing, Finishing and Counterboring

by A. W. Ehlers
Contributing Editor

The reader is no doubt familiar with conventional horizontal precision boring operations using single, horizontally opposed, spindles on Heald, Ex-Cell-O or Stokerunit precision boring machines. The usual practice is for the work holding fixture to travel toward the fixed roughing spindle, the fixture moving on the ways of the machine and being actuated by a hydraulic feed mechanism. After the roughing cut is completed, the fixture actuates a reversing dog which causes the fixture to travel in the opposite direction toward the fixed finishing spindle. Any intervening space between the spindle bridges not used for actual boring travel is traversed in high feed until the low feed dog is tripped.

This method of roughing and finishing drilled, reamed or cored holes in pistons, connecting rods, gear housings and other similar parts is rather conventional and is in daily use in many manufacturing plants. However, many design conditions indicate that a counterboring operation to precision tolerances is necessary.

The usual manner of counterboring the finish-bored hole has been to change setups on the boring machine and to perform the counterboring as a separate operation. This practice not only involves the additional complete cycle time of loading, counterboring and unloading, but it also involves a relocation of the work in the fixture. This relocation of the centerline of the precision bored hole with the spindle axis ofttimes results in the counterbore being eccentric with the original hole. True, the eccentricity probably will be measured in the third decimal place. However, an eccentricity of even .002" may sometimes mean that the misbehavior of the precision stepground shaft which is inserted in the counterbored hole will cause inspection and assembly trouble.

The writer was forced into experimenting with a single setup idea on a precision bored and counterbored hole in a cast iron housing in order to reduce the over-all labor burden.

Previous experience with double tooled bars, roughing and finishing on the same bar, proved that double tooling was practical within the length and diameter ratios of the boring spindles[1]. However, the double tooled spindle, where the roughing and finishing cuts were performed at the same spindle feeds and speeds, was definitely limited to the nonferrous metals when low micro-inch finishes had to be considered. Experiments on cast iron parts proved that at regular production feeds and speeds the

[1] *"Vibration vs Precision in Single Point Boring Tools," TOOL & DIE JOURNAL, February 1947, p. 68.*

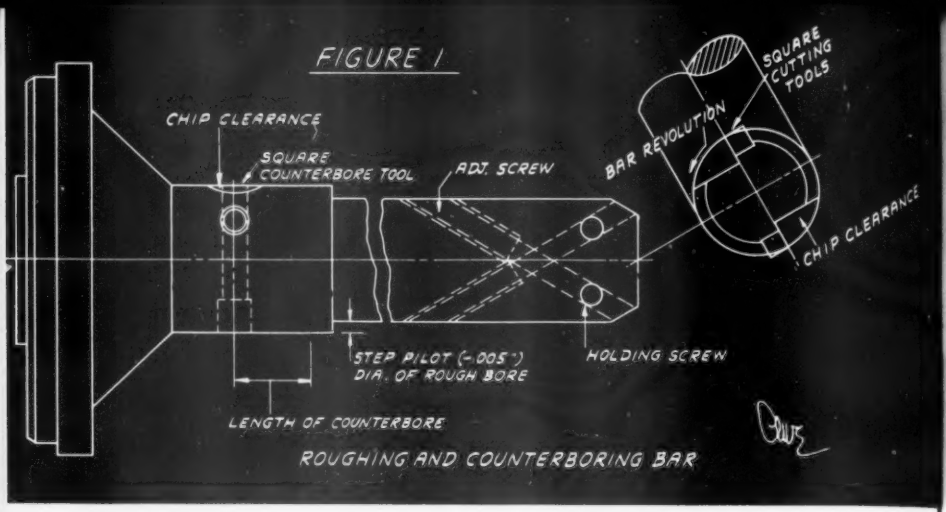


Fig. 1. For the first, or roughing cut, a speed that approximated 325 sfm was found most practical. Experience proved that double tooling of a single bar is practical providing the safe, anti whip, length/diameter bar ratio is not exceeded.

micro-inch finishes fluctuated between 170 to 280 rms. Also, sizing the cast iron holes was difficult when an off-set, double tooled, finishing bar was used as the total depth of cut had to be divided between the roughing and finishing tools in such a manner that the finishing tool was forced to remove more stock than is usually practical when sizing to "tenths."

The particular hole to be bored and counterbored demanded that the counterbore be bored on each or opposite ends of the hole. This meant that the rough and finish boring spindles must both be double tooled if the combined operations were to be accomplished in one operation.

Because of the sizing difficulty experienced in the double tooled roughing and finishing bars as explained above, it was determined that the counterbore tool should not begin its cut until the leading roughing or finishing tool had cleared the hole itself. This is, of course, an ideal situation and prevails when the depth of counterbore plus the length of the bored hole add up to a boring bar length that is within the desirable length to diameter ratio[1]. However, it was later found that the leading tool could be cutting at the same time as the counterboring tool if it became necessary to do so in the interest of reduced boring bar length and if the surface finish requirements of the hole could be sacrificed.

The diagrammatic sketches, Figures 1 and 2, both show the roughing and finishing boring bars with the tool pattern and the pilot steps for the counterboring tools. It will be noted that the steps for the counterboring tools are pilots for the rough bored hole in one instance and the finish bored hole in the other instance. These steps are usually dimensioned to clear their respective rough or finish bored holes by .002" to .005".

It was found practical to operate the roughing bar at an rpm to approximate 325 sfm, and the finishing bar at an rpm of sufficient speed to increase the surface feet per minute over the roughing spindle by 150. In the interest of hole micro-inch requirements the finishing bar feeds should be slower than the roughing bar feeds. Using a two-inch bore as an example, a representative roughing feed is .009" per revolution and a finishing feed is .004" per revolution. This boring speed and feed combination usually produces an average micro-inch surface finish in cast iron of approximately 70 rms.

In actual practice it became apparent that the counterbore on the roughing bar side had a rougher finish than the counterbore on the finishing bar side. This condition could be directly attrib-

uted to the differences in the feeds and speeds employed. To partially offset this difference in surface finish, a larger radius nose was ground on the roughing bar counterboring tool. This change in nose radius has to be found by trial and error as the variables in feeds, speeds and the analysis of the metal being bored precludes establishing a definite relationship in any other manner. If this change in tool contour does not lessen the difference in surface finishes to such a degree that it is no longer objectionable, then the feeds and speeds of the roughing and finishing bars must be altered to more closely approximate each other.

When the initial trial run of these counterboring bars was attempted, it was found that one or the other of the counterbores was always eccentric with the bored hole itself. This was the precise situation that was to be avoided in a single setup if the reasoning in the previous paragraphs was practical.

After much head scratching, it was finally noticed that the pilots were galling the bored holes on the same side or in the same direction as the evident eccentricity. Therefore, it was decided that the opposed boring heads were not in perfect alignment. But how could this be when perfect, straight holes could be bored on other bars with the heads in the same position? It took several sketches and many a conciliatory word to convince the irate machine tool repair man that we were not "cracked". The diagrammatic sketch, Figure 3, shows how we induced him to check alignment.

To correct the misalignment situation, a "tenth" dial indicator was fixed to the centerline of the fixture. The ball point of the indicator was used to traverse along both spindle OD's and by minute adjustment and a few choice cuss words, right or left traversing of the entire lengths of the spindles did not affect the dial indicator beyond a flutter and thus the spindles were in as close an alignment as was possible. The counterboring eccentricity either disappeared or was held to approximately .0002".

It was found that the tool life of the counterboring tools was not as long as the regular roughing or finishing tools. This fact was attributed to the evident increase in surface feet per minute of the counterboring tool and to the increased nose radius employed. To facilitate tool changes, a gage was devised to re-set these tools quickly, eliminating the taking of trial sizing cuts.

Fig. 3. The bored hole will be square with work face in spite of spindle misalignment if direction of work travel is square with face.

Fig. 2. The final sizing of the finished hole was done with a single point tool whereas the roughing cut was made with two tools 180° apart.

The writer wishes to conclude with the remark that this single setup of roughing, finishing and counterboring may be extended in scope and utility if solid carbide boring bars could be designed. Carbide bars would increase the bar length safety factor beyond that of the plain steel bars, in that the spindle whip could be held down as the safety factor of bar length being four times bar diameter was extended. The previous article, "Vibration vs Precision In Single Point Boring Tools," published in the February 1947, TOOL & DIE JOURNAL, amplifies this statement in greater detail.

The Manufacture Of Precision Castings

Part II

Investment Molding

The oldest form of precision casting is the investment or slip molding method popularly called the "lost wax method". Evidence is at hand in the form of cast objects to show that this method was used in one form or another in China as early as 1766 to 1122 B.C. during the Shang Dynasty, and also in early Greece.

In principle the method consists of making a wax replica of the part to be made which is placed in a container and covered with a suitable investment material. Heat is then applied to melt out the wax thereby leaving a cavity of the desired shape into which the metal is cast.

by G. Vennerholm
and E. Ensign
Ford Motor Company

After being dormant for many years the method was rediscovered by a Professor Cellini about four hundred years ago and lately has found extensive application in the jewelry and dental professions.

It was not until World War II, however, that American industry in general realized that this method makes possible the mass production of vital heat and abrasion resistant alloy parts, inherently difficult to machine, to tolerances so close that none or very little machining is required.

Figure 16 shows several such parts made in stellite, and Figure 17 shows the dimensions of one of these parts and indicates why ordinary methods of manufacturing were not satisfactory.

The Ford Motor Company had, however, before the war done considerable work in applying this method to the production of high speed steel tools of complicated shapes, notably milling cutters and similar intricate items requiring extensive machining operations.

The first consideration when using the investment method is the wax model and the wax itself. Obviously the part can ultimately be no more accurate than the model and the model no better than the tools and the materials used to form it.

The selection of suitable wax is based primarily on the shrinkage of the wax and its stability. In most cases where accuracy is desired it is necessary to compound a mixture of waxes to arrive at the desired properties. A typical composition which has been found satisfactory for a number of applications is:

33⅓% Blue Bulk Wax
33⅓% Superlo Wax
33⅓% Cincera Wax

It is well to mention at this point that it is common practice to join several wax models together to form a cluster, the joining wax becoming the necessary runners and sprues, and that the wax

used for this purpose need not be of the same quality as that used for the model.

In order to make the model, a carefully machined and polished die is used into which the wax is injected by means of a gun while the die halves are held together under pressure as shown in Figure 18.

The dies used, as shown in Figure 19, are generally made from steel for reasons of dimensional stability and wear resistance although considerable work has been done of late in casting the dies from low melting alloys, usually bismuth alloys chosen primarily for their ease of machining and working. In the design of the die, careful consideration must be given to parting lines and the ability of the die maker to machine the dies in such a manner as to eliminate any flash.

After completing the assembly of the wax models, the cluster is given a siliceous spray coating which lays smoothly against the wax surface and assures that the required finish on the casting is obtained. The assembly is then placed in a flask into which the investment is cast as shown in Figure 20.

Many investment compositions have been tried, but all of the successful ones for high temperature work have been basically silica, silica base binder, alcohol and water. No standard formula is

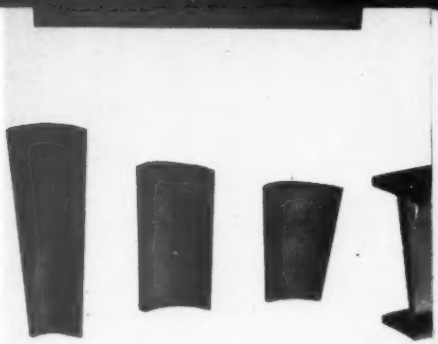


Fig. 16. From ancient China, through early Greece and rediscovery by Cellini four hundred years ago, many different metal crafts and skills have contributed to the present-day attainments in the "lost wax" or investment molding techniques by which these Stellite parts were produced.

available but the following composition has been used with considerable success: 67% silica, and 33% liquid made up of eight volumes silica base binder, one (1) volume of water and two (2) volumes of alcohol. Because of the difficulty in handling this material, it is generally mixed in batches and cast immediately into the flask which is vibrated to assure soundness and freedom from aid bubbles.

After the time necessary to cure the investment material, the mold is ready for burning. This is done by placing the same in a cold furnace and heating

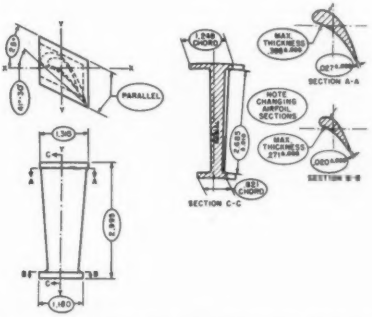


Fig. 17. Details of one of the pieces shown in Figure 16. The combination of intricate geometrical shape, difficulty in holding and poor machinability results in a "natural" for manufacture by investment molding.

Fig. 18. While the die halves are held together under pressure, the cavity which is to produce the model is filled with wax by means of a screw-feed hand gun.

at the rate of 300-400° F. to a temperature of 1400-1500° and holding at this temperature for two to three hours in order to completely burn out all of the wax and thoroughly dry the investment. Such a furnace is illustrated in Figure 21.

This firing cycle varies, however, depending upon the type of investment material and the temperature at which the cast is to be made. Investment casting is generally done in hot molds.

As the process has been developed at Ford's, the mold is removed from the firing furnace while hot and clamped on top of the specially designed melting furnace. The metal to be cast is melted in indirect electric arc furnaces in the quantity necessary to fill one mold. In operation the furnace is raised to a temperature of about 3000° while empty after which the charge is introduced through the arc. The weight of the material required is calculated by weighing the wax cluster model before the investment is made. After withdrawing the electrodes, the cast is made by inverting this assembly as shown in Figures 22, 23, 24, 25 and 26.

Although this process has been found very satisfactory for certain applications, the furnace was designed to permit gravity, pressure and centrifugal casting.

Aside from the vitally important work done during the war in the manufacture of hundreds of thousands of supercharger buckets, perhaps the most valuable application we have found to date for this form of precision casting has been in the manufacture of high speed steel tools. Figures 27 and 28 show the various steps in the manufacture of one of these from the wax die to the finished casting, as well as a number of different tools.

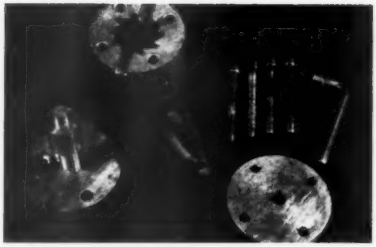


Fig. 19. A die, shown disassembled, in which is formed the wax models for casting a shell mill.

Fig. 20. A cluster made up of wax models and sprues positioned in a flask and ready for the pouring of the plaster investment.

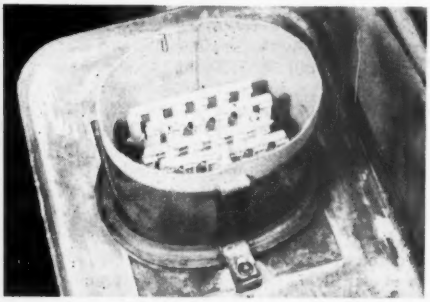


Fig. 21. After the silica plaster investment surrounding the wax clusters has "cured", the molds are ready for burning. Placed in a cold furnace, the molds are heated at an hourly rate of 300-400° F to 1400-1500° F, at which temperature they are held for two to three hours in order to completely burn away all of the wax and thoroughly dry the investment.

The greatest advantage of the investment molding method is that it permits the manufacture of practically any alloy, regardless of melting temperature, into almost any shape regardless of internal or external contour, with size the only limitation. The major disadvantage of the method, however, arises from the high cost of the raw materials used as well as the considerable time element required for curing and burning the investment.

Up to the present time it has not been found practical to salvage many of these materials. Extensive work is, however, progressing both here and abroad to remove or alleviate these objections with materials and formulas being developed to replace both the wax and investment used at the present.

In order that the potential possibilities of this method may be fully realized, the model material must be cheap, have small and definitely calculable shrinkage or growth, be easily injected and readily joined to itself, and be reusable without extensive reprocessing. It must also be capable of being held in a castable form over sufficient periods to permit feeding continuous casting equipment.

It is our belief that these ideal con-

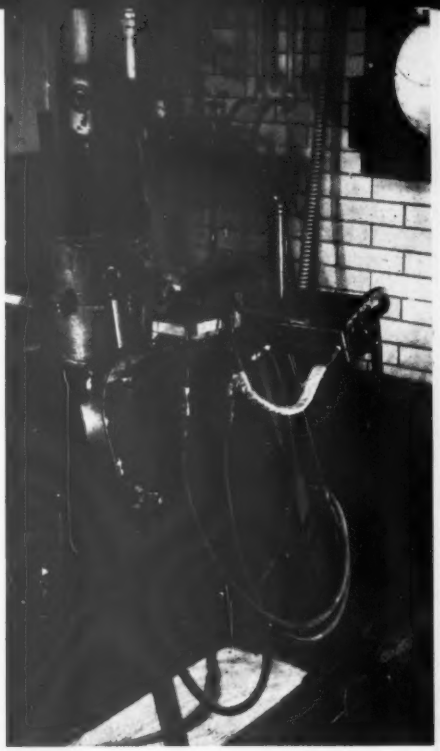


Fig. 22. The specially designed melting furnace used in the lost wax process as developed by The Ford Motor Company.

Fig. 23. The metal to be cast is melted in the indirect arc furnace, which is raised to a temperature of about 3000° F while empty, after which the charge is introduced through the arc.

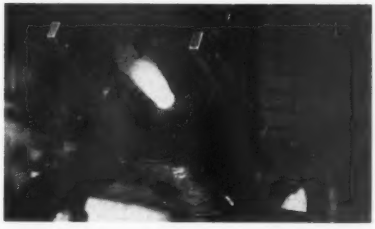
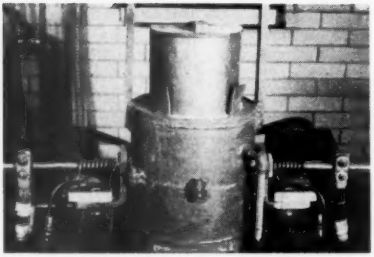


Fig. 24. Sufficient metal makes up each furnace charge to fill one mold. The correct amount of metal is calculated by weighing the wax cluster model before making the investment.

Fig. 25. With the wax model completely burned away and the investment material thoroughly dry, the mold is removed from the firing furnace, Figure 21, and clamped upon the electric furnace in which one charge of metal has been melted.



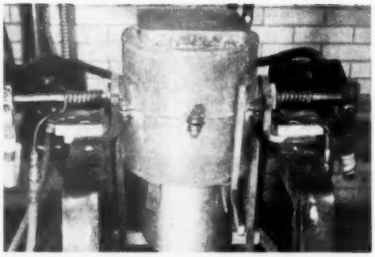


Fig. 26. After withdrawing the arc electrodes, the cast is made by inverting the furnace and mold. For the greatest flexibility in applications, this furnace was designed for all three casting methods: gravity, pressure and centrifugal.

ditions are near enough to realization to predict that the use of investment casting methods for manufacturing engine parts, gears, chassis parts, etc., will soon be at hand. Figure 29 shows a continuous mixing and casting installation for casting a new type investment material. *(Courtesy of the A.R.D. Corporation)*

Plaster Molding

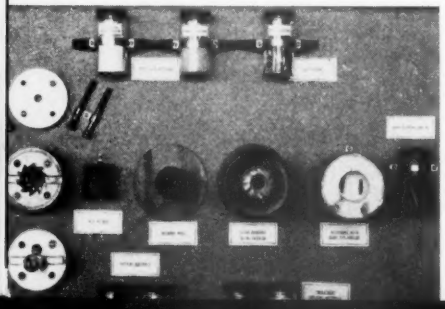
Metal casting in plaster molds has been used for many years in the manufacture of ornaments made from bronzes and low melting lead and tin base alloys. With the development of suitable aluminum alloys in more recent years, and the need for decreasing weight, particularly of automotive vehicles, this method may well be considered for precision casting especially of aluminum and bronze.

Fundamentally the process consists of casting a mold in plaster around a metal pattern and then, after suitably curing the mold, casting the metal.

As in the other methods of precision casting, the quality and exactness of the method depends primarily upon the amount of refinement one is willing to impart to the tools. Of these, the most important in this case are the models or patterns.

In plaster casting, the pattern is usually made of brass since this material is durable and less subject to the corrosive effects of the plaster slip. In order that the plaster may be parted from the pattern and the finished casting have a good finish, the finish on the pattern must be of very high quality.

Fig. 27. A display of the materials, mold components and step-by-step procedures involved in making a shell mill and from HSS scrap by the investment molding method.



Among the developments which have made plaster casting a desirable method of precision casting have been the development of new plaster mixes and improved techniques in its use. It has been found that low density plaster has better casting properties from the standpoint of dimensional stability during curing and calcining and produces a more faithful replica of the pattern surface.

By suitably controlling the density, inert content and calcining cycle, the plaster can be held to a minimum controlled shrink. A typical analysis of a metal casting plaster suitable for alu-

Fig. 28-A. This display of parts, ranging from a simple latch to an agitator component, is indicative of the infinite variety of shapes that can be produced by the lost-wax method of precision casting. Courtesy International Nickel Company.

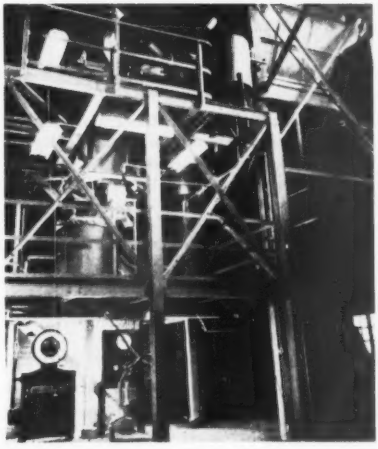


Fig. 29. An installation of equipment for the continuous mixing and casting of a new type investment material. Courtesy of the A. R. D. Corporation.

minum is thirty (30) parts by weight of gypsum, ten (10) parts of talc, two (2) parts of an accelerator and sixty (60) parts of water.

However, merely controlling the plaster mix ingredients is not sufficient to secure a good mold. The process must be carefully timed and manipulated from the time the dry ingredients are mixed until the mold is taken from the calcining furnace. The time of dry mixing, wet mixing curing time until the pattern is withdrawn, and time and temperature of calcining are dependent upon the size and shape of the plaster mold and will have to be determined for each casting to be made.

Figures 30, 31, 32 and 33 show a typical pattern, the casting of a plaster mold, a completed mold as well as placing cores in the mold. Figures 34 and 35 show the casting of metal in the plaster molds and a variety of representative aluminum and bronze castings made by this method.

New Developments

In discussing plaster molding, mention must be made of two developments which are as yet in their embryonic state in automotive application.

Several plasters are on the market which are basically gypsum to which has been added a plastic material. The resulting plaster when cast is very hard and durable and suffers small dimensional changes. These materials are very useful in making temporary tools to be used in plaster casting and also as molds for certain types of low melting alloy castings. Extensive use is being found for these materials in pattern shops and body styling departments. Realization of the full possibilities of this new type plaster depends upon the ingenuity of the person using it.

(CONTINUED ON PAGE 132)

Fig. 28. The Ford Motor Company has found the production of this great variety of high speed steel cutting tools to be a most valuable application of the investment mold method of precision casting.

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A Tooling Program For Forged Globe Valves

Part V

by Carl F. Benner
Assistant Editor

As stated at the conclusion of the last installment, the three sets of operations for machining the valve, inlet and outlet ports can be run on one machine or on three machines. If they are to be run on one machine, all bodies on the shop order will be run through on the valve port machining operation. A new tooling setup will then be made to perform the machining on either the inlet or outlet port, and the run made. Because these ports have the same machining, the tool setup remains the same for the third set of operations. However, the pads in the holding fixtures have to be changed to accommodate the change in position of the valve body for this operation. If three machines are to be used, then each machine is set up for one series of operations.

The outlet ports described in the foregoing are of the type used with the Parker Appliance Company's tube coupling shown in Figure 23. In making a tubing connection to this valve, the tubing, A, is cut off square, and the end is then flared to a 30° angle, which is the same angle as that of the seat or nose on the outlet port. The nut, B, and sleeve, T, are placed on the tubing and the flared end of the tubing fitted against the seat of the port. When the nut is run up on the threads of the port, the shoulder inside of the nut, B, contacts the shoulder on the sleeve, T, and as the nut is further tightened the tube flare is squeezed against the seat of the port to make a tight, unleakable fluid seal. If for any reason the threads, seat of the port, and the port axis are not concentric the possibility of securing a tight seal with the tube is somewhat remote. It is for this reason that such extreme care is taken during each step in the production of this valve body to insure that the finished machining of the outlet ports will produce threads, seat, and port axis which are concentric.

These offset globe valves are also produced with external or internal pipe threads, but the procedure on the Goss chucking machine is the same with the exception of the cutting tools used.

Components of Offset Globe Valve

In addition to the forged brass valve body, the other components which make

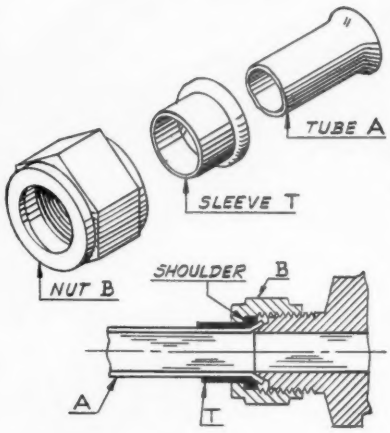


FIGURE 23

DRAWN BY M.H.

up a complete Parker offset globe valve assembly are shown in Figure 24, where a cross-sectional view of the valve is given with the individual parts grouped around it. These are identified in the accompanying table. The machining operations which are performed on each piece will be described along with illustrations of the tools and machines used.

Most of these components are produced from bar stock on automatic screw machines with some second and third operations. The components are: bonnet, B; packing cap, C; packing follower, D; slide bushing, E; slide, F; stem, G; jam nut, H; handle, J; jam washer, L; stem washer, M; packing, N; copper gasket, O.

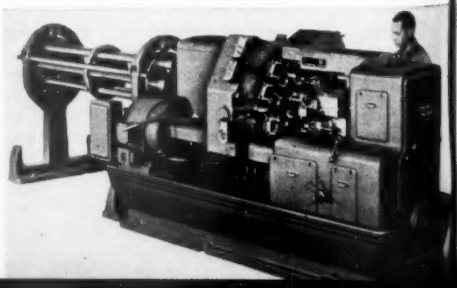
This valve has been designed by Parker engineers so that the stem (G) is held in place by washers (L) and (M). An external Acme thread is cut on the end of the stem which engages with an internal Acme thread in the slide (F) so that when the stem is rotated the slide will move up or down depending on the direction of rotation. The upper portion of the slide is hexagonal while the lower end is tapered to a 60° included angle. The hexagonal hole through the slide bushing (E) corresponds to the external shape of the slide (F). A sliding fit allowance of from .010″ to .020″ is provided by the dimensioning of these two parts. The slide bushing functions as a holding member and joins body (A) and bonnet (B) together by means of the external threads cut on it and the internal threads of the body and bonnet. The slide bushing also serves as a guide in which the slide moves up and down and because of their mating shapes the slide is prevented from rotating when the stem is turned.

Therefore, in the operation of the valve the slide is raised to open the inlet port and lowered to close it. This up and down motion is imparted to the slide through the Acme threads on the stem and in the slide when the stem is turned.

The closing action takes place when the slide (F) contacts the seat (K) of the body. Because the stem is held in place by washers (L) and (M) it does not rise out of the valve when the handle is turned to the open position.

The packing used in this valve is of a plastic form molded in a die to the shape shown in (N). The packing follower (D) is forced down on the packing by the packing cap (C) when the cap is tightened. The contact between these two parts is through a shoulder inside of the packing cap (C) and a shoulder on the packing follower (D). Thus leakage past the stem is prevented by the pressure set up on the packing when the packing cap is tightened.

Fig. 25. Front view of the Greenlee 6-spindle Automatic Screw Machine. Arrangement of spindles, main tool-slide and cross-slides as detailed in the valve tooling descriptions, is clearly shown.



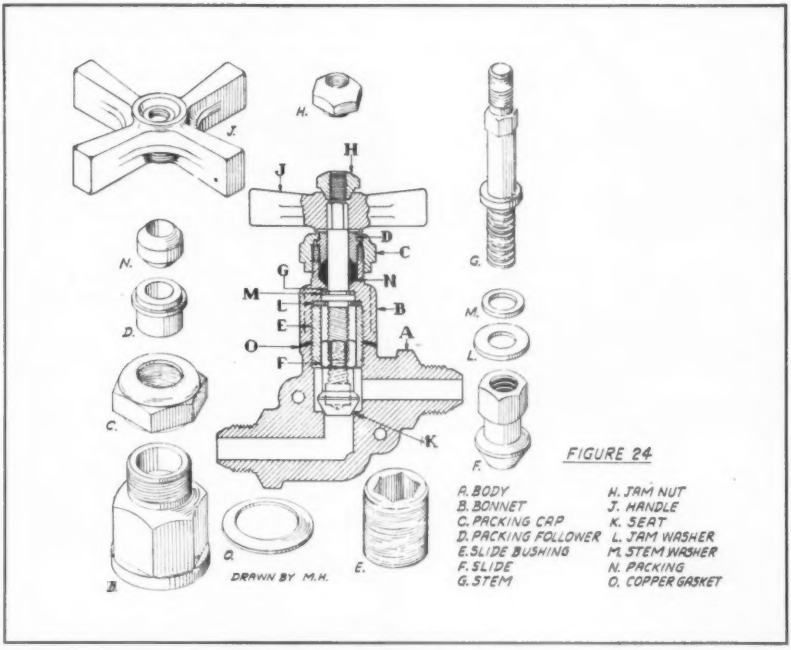


Fig. 24. Cross-sectional view of a Parker Brass Offset Globe Valve. Machined, working parts of the valve other than the forged body are shown and identified for the respective tooling operations.

Bonnet

The bonnet, B, Figure 24, is produced from 1⅜" round brass bar stock. The first operations are run on the Greenlee 6-spindle automatic screw machine, Figure 25. This machine has six spindles, three front and three rear cross-slides, and seven full length T-slot surfaces on the main tool-slide for setting up end working tools. This arrangement permits machining operations to be performed on the end of the bar stock by the end working tools such as drilling, facing, counterboring, countersinking, boring, reaming, recessing and threading. At the same time turning and

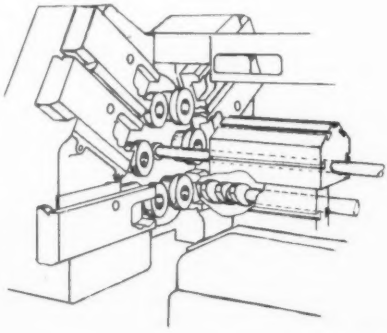


Fig. 26. Assembly view of the Greenlee tool working area. The depth of cut made by the end working tools is determined by the location of the tool along the surface of the main tool-slide, since the main tool-slide makes a full stroke during each cycle. The cross-slides operate independently, therefore the depth of cut made by the cross-slide tools is set up for each cross-slide individually.

forming operations can be done with tools set up in the cross-slides.

Figure 26 illustrates the arrangement of spindles, cross-slides and the main tool-slides and makes clear what action can take place when bar stock is protruding through the collets and revolving. With tool holders mounted in the T-slots of the main tool-slide and carrying end cutting tools, and with the required turning or forming tools mounted in the cross-slides, operations can be performed on the end of the bar stock by the tools on the main tool-slide moving into the work while the tools on the cross-slides also move into the bar. Thus two operations can be performed on the workpiece simultaneously. Since the spindles revolve, the condition is that of the workpiece revolving and the tools moving into the work.

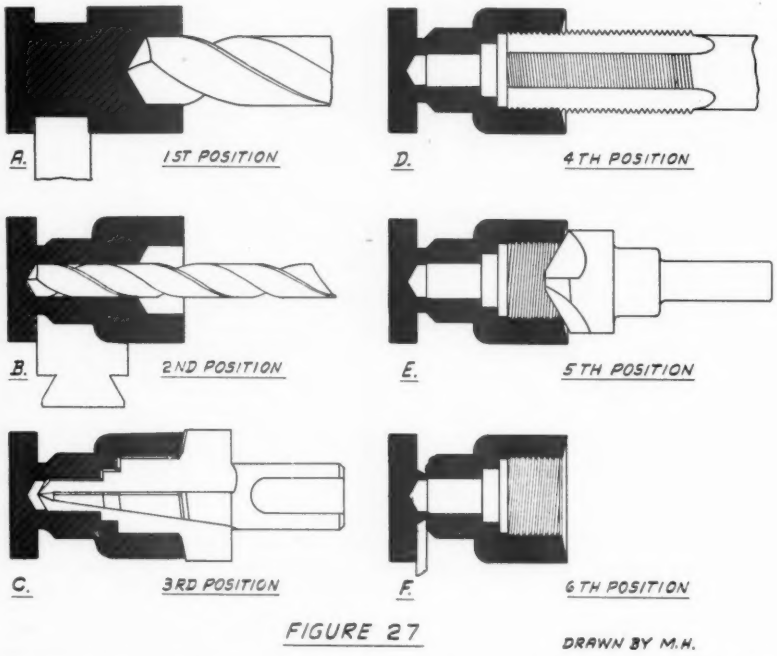


FIGURE 27

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Fig. 27. The changes in shape of the workpiece as the successive operations are performed by the Greenlee 6-spindle Automatic Screw Machine. The shapes of the tools employed are indicated at each position.

The operations performed on the bonnet by the Greenlee 6-spindle automatic screw machine are illustrated in Figure 27. After the predetermined amount of stock is fed by the pusher out through the collet to the stop at the sixth position, the collet is automatically closed and locked.

The main tool-slide carrying a 51/64″ drill in the first spindle position moves into the work 41/64″ deep. At the same time the first spindle cross-slide, set up with a rough form cutting bit, advances to the work for a turning cut. Thus as the operations of the two tools are com-

pleted and the tools are retracted, the resultant shape of the workpiece is that shown at A, Figure 27.

After the tools have been retracted, the spindle carrier and stock reel index to the next position, the spindle in number one position has moved to the number two position. At this station the main tool-slide is set up with a 23/64" drill which advances to drill through the entire depth of the bonnet while a dovetail form tool, mounted on the cross-slide, moves in. This form tool reduces the diameter of the stock to within .010" of the major diameter of an external thread which is run on in a subsequent operation, puts a radius on the top of the bonnet and chamfers for the first threads just mentioned. Results of the drilling and forming are indicated at B, Figure 27. After these two tools are retracted, the spindles index, advancing the spindle in the number two position to the number three position.

At this station only one operation is

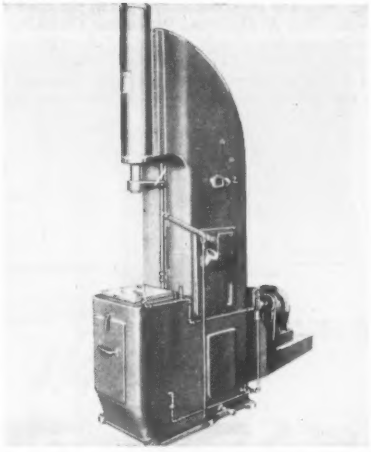


Fig. 28. An "American" Hydraulic Press, type V-2, 6-ton capacity, as used for straddle broaching two opposite surfaces of the hex shaped bonnet at one pass.

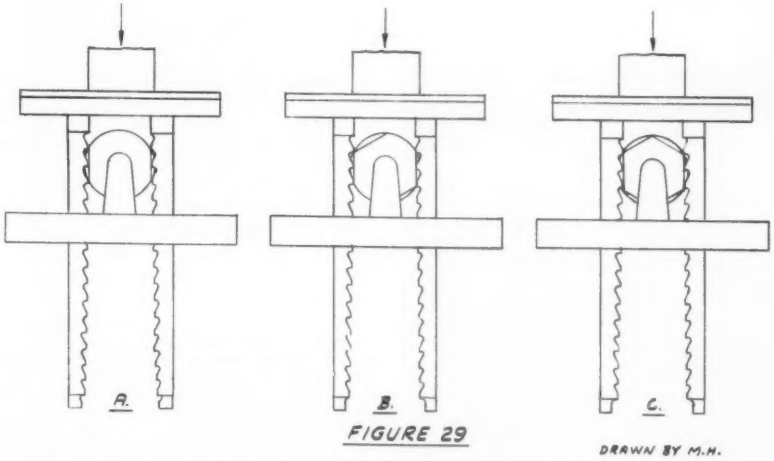


Fig. 29. Indicating the shape imparted to the bonnet by the three successive straddle broaching passes. An adapter, which holds the bonnet, is set in a cradle so that the bonnet can be indexed manually. After the finish of the first downward pass, A, and the broach has returned to its starting point, the work-holding fixture is indexed 60° to the second position ready for the second pass shown completed at B. This cycle is repeated for the third pass to complete the operation, C. The result of this broaching operation is shown on the completed bonnet, B, Fig. 24.

Fig. 30. The progressive changes in the cross section of the bonnet due to the operations performed on the Goss & DeLeeuw Automatic Chucking Machine. The threaded adapters used to hold the workpieces are clearly shown. Concentricity of the counterbore and external threads with the internal threads of the bonnet are insured with the adapter method of chucking. The adapters are set up in the chucks of the Goss machine and the bonnets are run onto the threads of the adapters by the operator during the loading position of the cycle.

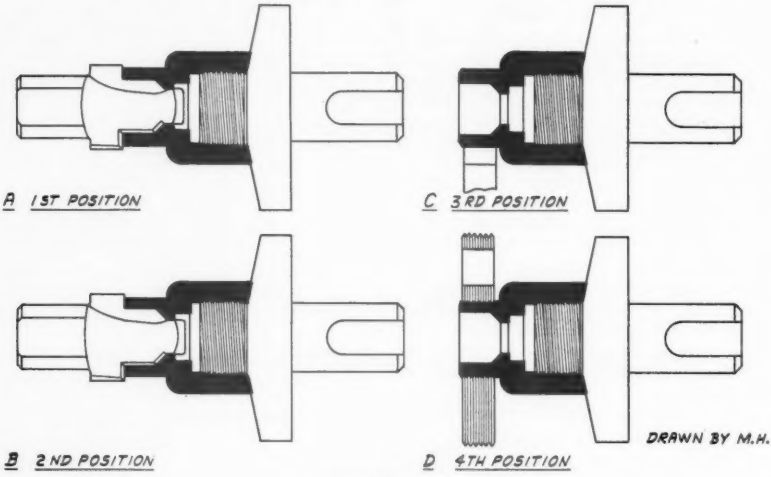
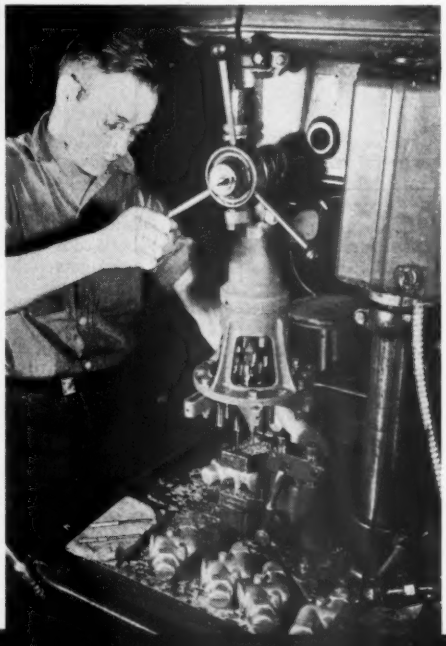


FIGURE 30



performed, that of step counterboring by a step counterbore mounted on the main tool-slide. This tool deepens the 51/64" hole drilled by the spindle in the first position, and squares the bottom of the hole, into which washer L, Figure 24, rests in the final assembly. It also

(CONTINUED ON PAGE 136)

Fig. 18-a. This combination of equipment, as used to drill the holes in the valve body mounting bosses, was inadvertently mis-labelled in Part II of the series, TDJ, January 1947, page 75. The original photograph was a dud, due to photo flash gun trouble, and a retake was shot of the same operation being run on different equipment, all unbeknownst to us. As shown, the setup consists of a Delta (Milwaukee) drill press plus a "Multi-Drill" multiple spindle drilling head as made by the Commander Manufacturing Company of Chicago. Congratulations to our eagle-eyed readers who caught the off-base caption!. Ed.

Whips the TOUGH jobs Too!

The severely interrupted cut in facing this crank-shaft requires the steep negative back rake shown.

Firthite sintered carbide tools take the hard jobs as well as the easy jobs in stride—as evidenced by the case history shown above.

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THE JOB

PART: Crank forging.
MACHINE: Turret Lathe.
OPERATION: Face crankshaft cheek.
CONDITIONS: 182 RPM (over 300 feet per minute)—at 0.006 FPR.

THE TOOL

FIRTHITE Grade TO4, 1" x 1½" x 3" —35° negative back rake, 18° positive side rake.

RESULTS

9 to 12 pieces per grind as against 3 with former tools.

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How To Machine Aluminum And Magnesium With Carbide Tools

Machining aluminum and magnesium alloys with carbides presents no particular difficulties. This is true whatever the operation, turning, boring, milling, etc., and with carbides, these light metals can be machined at extremely high speeds, usually the maximum speed obtainable on existing equipment. The prime requirement of the machine tools is that they be in good condition. For greatest tool life carbide tools should be hand or machine lapped to a keen edge after grinding, and provided with fairly liberal rake and clearance angles.

General Machine Considerations

Since the highest possible operating speeds of which the machines are capable can usually be used when machining the light alloys with carbides, machine ways should be leveled with a precision level; any "spindle whip" should be taken out; bearings should be tight enough to eliminate vibration but not so tight that they will burn out at high speeds. These precautions reduce chance of machine difficulties. Correcting fixture unbalance by static and dynamic balancing may also prove helpful.

Due to the comparative softness of aluminum and magnesium, these alloys should not be clamped too tightly because they may distort. Improperly designed clamping jaws may also mar finished surfaces. Holding fixtures are often lined with rubber, felt, or some other suitable material to prevent marring the work.

Otherwise, the setups for machining light alloys with carbides are similar to those used when cutting brass or steel. This is especially true of lathe work. In milling light metals, flywheels are seldom required, although sometimes they are of value in producing extremely flat surfaces. In addition, use of a cutter spindle flywheel on older machines helps overcome the effects of chatter and vibration at high speeds.

Feeds and Speeds

Table 1 gives average recommendations for machining aluminum. Higher speeds are frequently possible, depending on the job, machine and material. In most instances, it will be found that maximum cutting speeds available on the machines are somewhat *less* than optimum possible speeds as determined by the tools themselves. Here, heavier feeds and depths of cut may be used to advantage. The extent is limited, of course, by the possibility of distorting a section under cutting tool pressure. Maximum feed is also restricted by the character of the finish desired.

by Carroll Edgar,
Carboloy Company, Inc.,
Detroit, Michigan

Feeds should be relatively high so that heat generated will be retained in the *chips* rather than in the workpiece. Carboloy tools cut at red heat without

Table I

MATERIAL TO BE CUT		POWER CONSTANT	7/16" to 3/4" Cut .020" to .030" Feed		3/16" to 3/8" Cut .015" to .025" Feed		5/64" to 5/32" Cut .010" to .020" Feed		1/64" to 1/16" Cut .006" to .012" Feed		.005" to 1/64" Cut .002" to .008" Feed	
			Speed F.P.M.	Carbide Grade	Speed F.P.M.	Carbide Grade	Speed F.P.M.	Carbide Grade	Speed F.P.M.	Carbide Grade	Speed F.P.M.	Carbide Grade
BRASS AND BRONZE	Hard	10	100-250 **175**	**44A**	125-275 **200**	**44A** 883	150-350 **250**	**883**	200-400 **300**	**883** 905	300-600 **400**	**883** 905
	Soft	4	150-300 **225**	**44A**	175-325 **250**	**44A** 883	200-400 **300**	**883**	300-500 **400**	**883** 905	350-1000 **500**	**883** 905
	Castings	3	175-325 **250**	**44A**	200-500 **300**	**44A** 883	250-600 **350**	**883** 905	300-1000 **450**	**883** 905	400-1500 **600**	**883** 905
ALUMINUM	Bar Stock	4	150-300 **225**	**44A**	200-500 **275**	**44A** 883	250-600 **325**	**883** 905	300-1000 **400**	**883** 905	400-1500 **500**	**883** 905
ZINC ALLOY	Die Castings	3		**44A**	200-500 **300**	**44A** 883	250-500 **350**	**883** 905	300-600 **450**	**883** 905	400-1000 **600**	**883** 905
COPPER		4	100-300 **200**	**44A** 883	150-350 **250**	**44A** 883	200-500 **350**	**883** 905	300-600 **450**	**883** 905	400-1000 **600**	**883** 905
PLASTICS					250-500 **350**	**44A** 883	300-800 **450**	**883** 905	400-1000 **600**	**883** 905	500-1500 **800**	**883** 905

damage to the tool. If the work gets too hot, however, it may warp. Therefore, light, thin sections of magnesium or aluminum should be machined at the highest possible speed to prevent dimensional variations.

Tools

SHAPES. The low chip pressures developed when machining the light alloys permit a rather wide latitude in choice of tool angles. In general, carbide tools can be ground to approximately the same rake angles used on HSS tools for similar work. Relief angles (primary clearance) should be from 6° to 9° for most jobs. Clearance should be enough so that tool clears work, to prevent rubbing. This usually gives a total clearance of 10° to 15°. Side rake of carbide tools should be between 10° and 30° with a minimum of 10° in order to make the cutting wedge acute. An end cutting edge angle of 15° to 20° has been found to work well for light alloy work. Nose radii should be kept as small as practicable.

The higher speeds at which carbide milling cutters operate, implies the desirability of ample chip space. The surface in the space where the chip curls ahead of the cutting edge should be smooth to give free chip flow.

GRINDING. Cutting edges of carbide tools should be ground to a keen edge and cutting faces lapped for optimum results. Sharp tools are even more essential when machining magnesium than for aluminum since dull tools may create a fire hazard with magnesium alloys. This hazard is particularly present when feeds are light and chips thin.

Carbide tools should be hand lapped after each grinding in order to produce the sharpest possible cutting edge and to remove any grinding marks from the tool faces. Lapping the tools will further improve the finish on the workpiece.

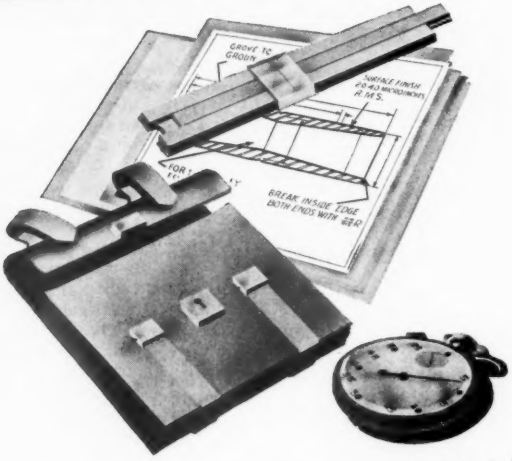
In other respects, the procedure for grinding carbide tools for machining magnesium and aluminum alloys is the

Table 1. Average recommended speeds, feeds, cuts and grades of Carboloy cemented carbide for machining non-ferrous and non-metallic materials.

A BUYING GUIDE FOR ABRASIVES

POINT No. 3

ABRASIVE ENGINEERING



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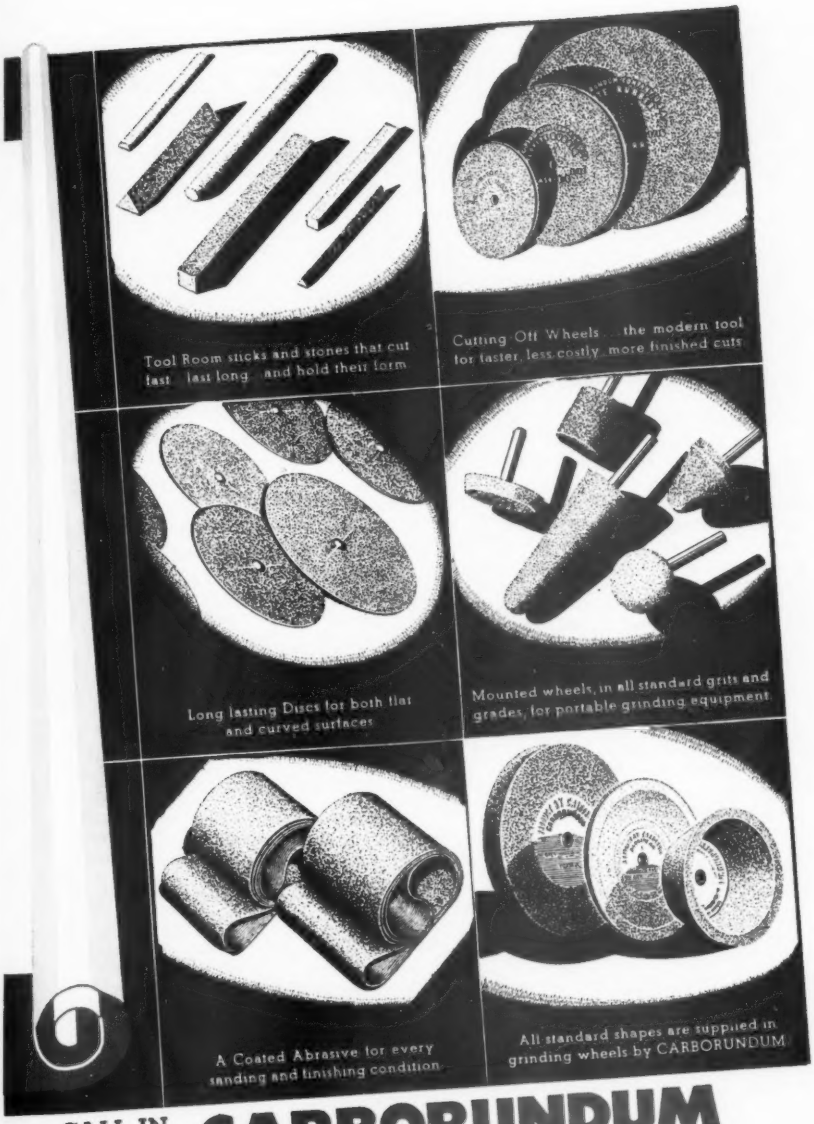
A Good Rule for Good Grinding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Cutting Off Wheels . . . the modern tool for faster, less costly, more finished cuts
Long lasting Discs for both flat and curved surfaces
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same as that used for tools employed in cutting other materials. It will be well to remember, however, that carbide tools should be removed and re-sharpened when they show the first signs of dulling, rather than waiting until they are so dull they will not cut properly. This practice actually conserves grinding time since a badly dulled tool requires considerable stock removal to re-sharpen it properly. Many shops, rather than depend on the operator to determine dullness, run carbide tools on a given job for only a pre-determined number of pieces. Tools then are replaced and re-sharpened. However, the number of pieces involved is quite high since carbide tools remain sharp longer than do steel tools.

GRADE OF CARBIDE. For optimum results, a hard grade of carbide should be used when machining the light alloys. Softer grades of carbide and those generally used for machining steels are not satisfactory for cutting aluminum and magnesium. The reason for this is that many light alloys are quite abrasive even though they are "soft" according to Brinell or Rockwell tests. Certain aluminum alloys, for instance, contain appreciable amounts of extremely hard aluminum oxide which causes steel tools to wear rapidly. Therefore, *the most wear resistant grade of carbide* is usually most desirable.

Straight tungsten grades of Carboloy are recommended for all light nonferrous metal machining. For general jobs, Carboloy 883 may be used, at least at the start. Harder, softer, or tougher grades may then be tried if desired. For heavy roughing on light metals or where machine is not as rigid as desired, Carboloy 44-A, tougher but not quite so wear resistant as 883, has proved very effective. Grade 905, which is more wear resistant but not so tough as 883, is also used for taking finishing cuts on magnesium and aluminum.

Coolants

The chief function of coolants when used with carbides in machining light alloys is to keep down the temperature of the workpiece in order to prevent its distortion. Also, in machining magnesium it is important to keep down the temperature of the work in order to minimize the fire hazard. A good grade of soluble oil works well with aluminum. A mineral oil is recommended for use with magnesium. Water, soluble oils, or oil-water emulsions should not be used on magnesium alloys since these coolants tend to increase fire hazards.

Specific information as to coolants for machining specific magnesium and aluminum jobs can readily be obtained from reliable coolant suppliers.

Chip Control and Disposal

Carbide tools should be designed so that they will direct chips away from the cut, due to ease with which the finished surfaces of the relatively soft magnesium and aluminum workpieces are marred. As for disposing of chips, removing them from vicinity of the cut, this can be accomplished when necessary either by means of an air blast, by a stream of coolant under pressure, or with a suction arrangement.

Editor's Blueprint For April

Quality Control Proves Itself in Assembly

—a national authority on Quality Control, Martin A. Brumbaugh, refutes a British contention that there is no money to be saved in applying Quality Control techniques to assembly operations.

Production Speed With a Progressive Die

—the design detail and know-how brought to bear on a five-station progressive die, resulting from a demand for quantity production at the least possible cost. This is the first of a series of articles on high speed progressive dies.

A Tooling Program for Forged Globe Valves, VI

—the machine operations and tooling for converting brass bar stock into the valve packing caps, packing followers and slide bushings. The Cone, Greenlee and Brown & Sharpe setups are detailed by assistant editor Benner.

Press Room Accidents

—Basil Burns, Chief of Accident Investigation for the Western Electric Company, points out that, for press room accident prevention, know-how is not enough. His answers to case questions are of vital importance to every press operator and owner.

Hydraulic Circuits And Applications

Editor's Note: Our third feature presentation of hydraulics know-how from the recent Machine Design Conference of the Cleveland Engineering Society. For the first, "Hydraulic Valves and Control Devices," see TOOL & DIE JOURNAL, November 1946 and January 1947; the second, "Hydraulic Applications From The Users' Viewpoint" appeared in February 1947 TOOL & DIE JOURNAL.

by Ransom Tyler
The Oilgear Company, Milwaukee, Wis.

Hydraulic circuits can be discussed from the standpoint of the operator, who asks, "What can they do? What are their characteristics?"; from the standpoint of the designer, whose question is "How can I make them so they will do it?" or from the standpoint of the maintenance engineer who is required to get a machine into production, and who must find the bugs in a circuit and lick them. The problems of the latter are often the result of insufficient interchange of ideas between the first two and could have been prevented if the operator had correctly assessed his requirements and presented them to the designer in such a way that the designer could correctly evaluate them and design to meet them.

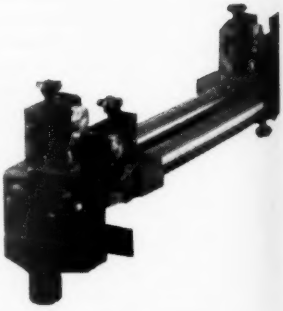
As a circuit designer I want to tell the operator some of the things he can expect from a hydraulic circuit, and to tell other designers how to determine if their design will fit the job.

Methods and Results

The gentlemen who have talked before me have encroached on my subject. This was necessary in order to illustrate the uses possible from the equipment they were describing. It is not my purpose to catalog a great variety of circuits, as that could go on indefinitely and can only be done by relating the specific items of equipment to specific problems. A discussion of methods and results is more appropriate.

Furthermore, it is unwise to accept fixed values of the limitations characteristic to fluid power equipment. For example, yesterday afternoon we heard one speaker state that piston pumps were generally limited to 1200 or 1800 rpm in speed. A little later another speaker cited an example of a pump of this type being driven at speeds varying from 2100 to 9000 rpm. If a limitation can be lifted in a 5:1 ratio in two hours, what is in store for the next two weeks, or two years?

ABC's OF BAR GRINDING FIXTURES for Cincinnati Centerless Grinders



How long is *long?* In centerless grinding operations on bars, tubes and rods, it's about 15 inches, for beyond that length, such work requires its own distinctive Long Bar Grinding Fixture. Shops equipped with CINCINNATI Centerless Grinders have a choice of four general types:

- Type A—for comparatively short bars of small diameters.
- Type B—for medium diameter, medium length bars.
- Type C—for long, medium diameter bars.
- Type D—for long, large diameter bars (No. 3 Centerless only).
- For nonmetallic tubes and rods (capacity, ⅛" to 3" diameters, lengths up to 5 feet).

These types cover practically the entire range of bar grinding requirements. ¶ It's not necessary to tie up the machine permanently for bar work, although the most economical results are obtained when quantities are sufficiently large for a run of several days or weeks. The long bar fixtures are removable and your CINCINNATI Centerless can be set up at any time to grind the shorter parts—thrufeed or infeed—so common to the average shop. ¶ These bar grinding fixtures are only a few of the many attachments available for CINCINNATI Nos. 2 and 3 Centerless Grinding Machines. A variety of attachments are illustrated and described in the machine catalogs. Write for publications G-456-4 and G-438-3.

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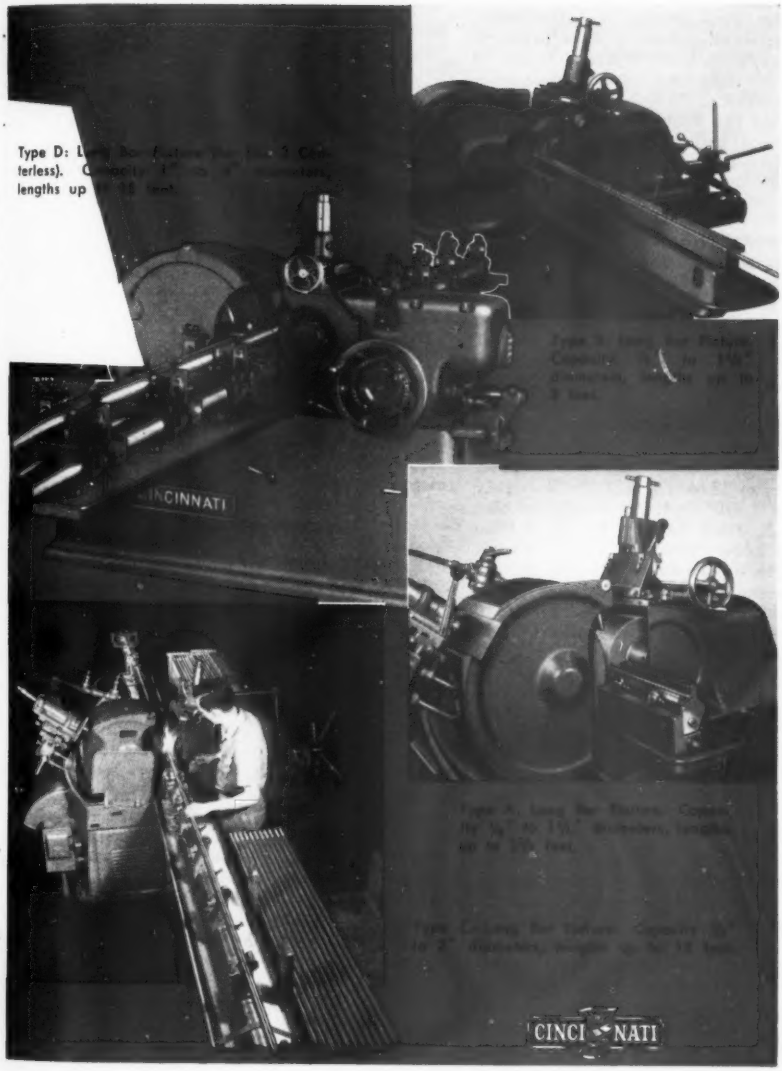
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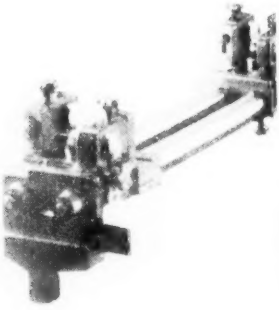
ABC's OF BAR GRINDING FIXTURES
for Cincinnati Centerless Grinders



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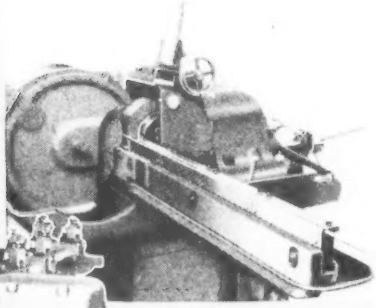
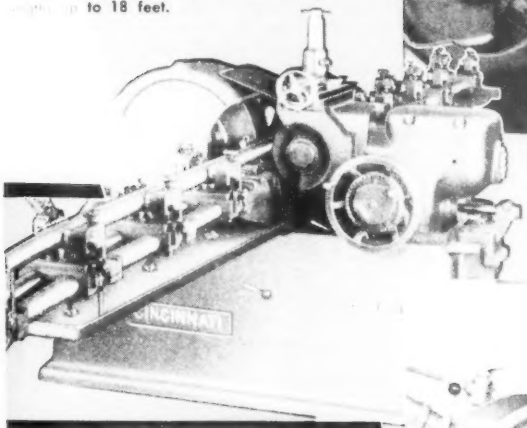
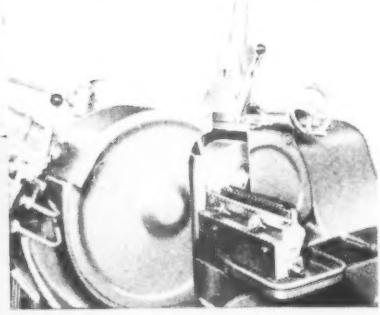


Type D: Long Bar Fixture (for No. 3 Centerless). Capacity 1" to 4" diameters, lengths up to 18 feet.



Type B: Long Bar Fixture. Capacity ⅛" to 1¼" diameters, lengths up to 8 feet.



Type A: Long Bar Fixture. Capacity ⅛" to 1¼" diameters, lengths up to 2½ feet.

Type C: Long Bar Fixture. Capacity ½" to 2" diameters, lengths up to 18 feet.

CINCINNATI

To illustrate what might be expected of fluid power let us consider the following hypothetical problem:

Suppose you, having no established facilities, were called upon to produce, let us say, a tank for household use, to be used for impregnating materials with a pest repellent. What processes might be used in the fabrication and in what ways would hydraulic power transmissions be desirable.

Metal Drawing

An obvious process would be drawing the tank from a metal sheet. The construction and limitations of both hydraulic and mechanical presses for this purpose are quite generally known, but we mention here the characteristics of hydraulic power which might make it desirable for a drawing press so that the list will be complete. The first is the possibility of obtaining a uniform drawing speed over the full draw stroke and of being able to adjust this speed. Second, we have the ability to easily limit the force applied. Third, we can, if desired, dwell for any period of time wanted, under pressure. And fourth, the length of stroke can be set to conform to the exact requirements of the job for most efficient production. In many cases none of these chacteristics are urgently required, and in any such case it is quite possible that the particular object can be produced more economically on a mechanical press. However, when these control characteristics are important, hydraulic drive is usually the most convenient method of obtaining them.

Plastics Molding

A second process might be plastics molding. Here also a press is required, and the same characteristics would be considerations. If an injection process is used, however, another chacteristic is is required, that of properly sequencing the injection plunger with the press cycle. It is comparatively easy to hydraulically maintain controlled pressure on the press, and operate the plunger at the most desirable time, speed and pressure, interlocked, if necessary, with other movements.

Plywood Fabrication

Perhaps plywood would be selected for fabrication of the tank. Hydraulic equipment might be used in many of the operations in producing plywood. The veneer lathe drive could perhaps benefit from the speed control characteristics possible from a hydraulic transmission. Or the knife may be equipped with hydraulic feed to permit an easily controlled adjustment of the thickness of the veneer. Conveyors may be adjustably synchronized with the lathe hydraulically, and, of course, the press is almost certainly hydraulic, as control of the previously described characteristics is essential in plywood gluing.

Metal Spinning

Metal spinning may be chosen for the process. Hydraulic spindle drives might be used here in order to obtain a control of the speed to match the requirements of the work, and the feed for the tool may be a fluid feed.

Centrifugal Casting

The tank might be produced by centrifugal casting. For this, an ideal setup constitutes a bank of centrifugal casting drives, installed to obtain the benefit of controlled speed, controlled acceleration, and dynamic braking in the production of castings of many sizes and shapes.

Machine Control

If machined elements are to be included, the feeds of the drilling, milling, boring or turning machines may be hydraulic, or the reciprocating or oscillating motions of grinders, planers or shapers on which the parts are produced may be equipped with hydraulic drive; a specific example being that of a large planer which uses hydraulic power to quickly and smoothly drive and reverse the heavy table, and feed the work past the tool at the necessary controlled speed.

If paper or paper board is used in the manufacture it may be produced, processed, or printed on machines driven by hydraulic motors, which are capable

of controlling the speed through wide ranges or the rolls may have been wound on hydraulic winders which control speed and torque to produce desirable tension characteristics.

In fact, it is hardly necessary to say that no matter what method of production would be chosen for manufacturing this hypothetical tank, hydraulics might well be employed.

Now, let us examine some of the processes just mentioned to find out what it is that makes hydraulic operation desirable and what the limitations are; then we will be able to weigh the merits of hydraulics against other systems, and to consider methods of best realizing the peculiar advantages of hydraulic power to meet the conditions set up in any specific problem.

Hydraulic Control of Force

The first processes make use of presses. These illustrate the properties of hydraulic drives in easily producing heavy forces, but more important, show the not so obvious fact, that hydraulic power permits the control of that force, easily, accurately, and in a metered and indicated amount; the control of the speed of application; and permits an indefinite dwell under these controlled pressure conditions. Examination of drives used on lathe spindles, conveyors and the like indicate the ease of speed control thru wide ranges, and the control of direction of rotation is an important factor in their application. When used to power winders, booster drives, and testing equipment, the control and measurement of torque are the paramount consideration. When applied to reciprocating masses such as planers, grinders, honing machines, and the like, fluid power is capable of producing smooth, shockless reversals with a minimum of overtravel, as well as providing a variable speed. Feed controls emphasize the control of speed and the facility with which extreme conditions can be met. In all of these the desirable element is control; control of force, torque, direction, speed, acceleration, rate of application of force or torque, timing, or other elements. The outstanding contribution of fluid power is the flexibility gained in this control and the ease with which this control can be applied.

Energy Storage

We might pause here to say that there are other characteristics which may become desirable in special applications. One is the ability to store large amounts of energy for sudden release, such as the most recently developed plane catapults. Here energy stored at the rate of perhaps 300 to 500 hp is released at rates up to 10,000 hp. Others, such as the freedom from fire and explosion hazard are so obvious that no further discussion is required. It is the control characteristics and limitations that are of importance in the discussion of fluid power circuits.

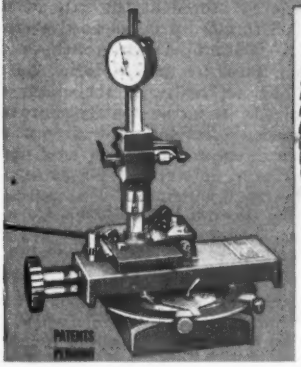
Design Limitations

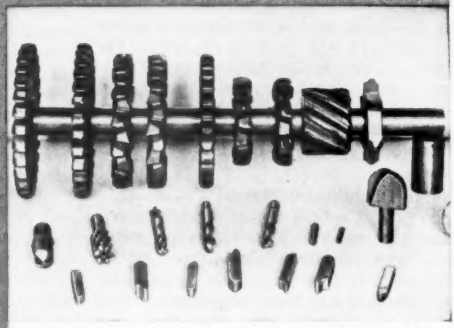
To return to the question of limitations, we do recognize that, while equipment can be built to meet almost any reasonable set of requirements, a general design has limitations. For instance, while it is possible to design pressure generators to operate at pressures practically up to the ultimate strength of the materials used, any particular design will certainly have a limited maximum pressure. Likewise, the other characteristics. However, the point which is not so generally considered is the limitation on range. For example, a pressure limiting valve designed so that its spring pressure can be entirely relieved, and still show an appreciable resistance to flow thru it. Or which, if set for low pressure may have instantaneous peaks limiting its usefulness.

Likewise, a variable displacement hydraulic motor, operated under conditions such that constant pressure and flow is maintained at its inlet, will deliver a substantially constant power output with varying speed (displacement) over a range of 3 or 5 to one. However, if the critical range is exceeded frictional torque losses become great *in comparison* to torque output, and the output characteristics are no longer desirable.

(TO BE CONTINUED)

Is Your Tool Room a Bottleneck for Those Badly Needed Production Tools?





Here are a few standard cutting tools that have been ground on the radiform into special forms.

If your production is being delayed in your tool room, it will pay you to investigate the Radiform Wheel and Tool Former for simplifying your difficult tool grinding jobs. Radiform will save you time, money, and give you precision results you had never before hoped for.

With a Diamond Wheel, carbide tools are no more difficult to grind than high speed steel tools.

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Manufacturers also of Meyco Carbide Drill Jig Bushings.

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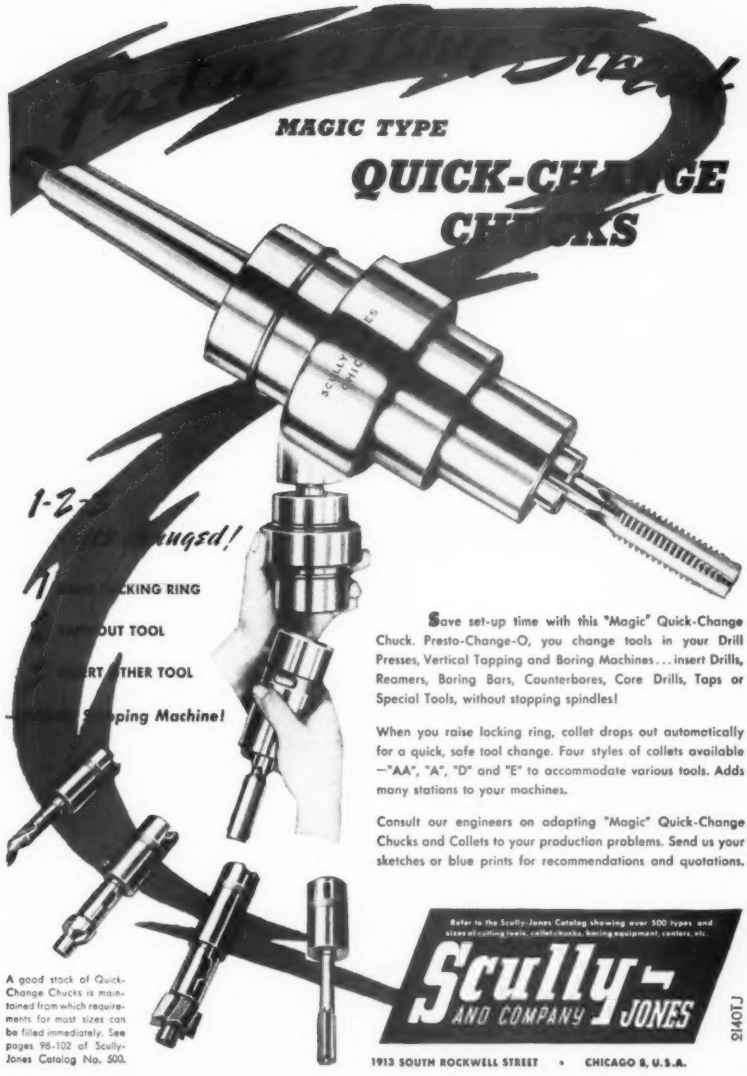
MAGIC TYPE

QUICK-CHANGE CHUCKS



Save set-up time with this "Magic" Quick-Change Chuck. Presto-Change-O, you change tools in your Drill Presses, Vertical Tapping and Boring Machines... insert Drills, Reamers, Boring Bars, Counterbores, Core Drills, Taps or Special Tools, without stopping spindles!

When you raise locking ring, collet drops out automatically for a quick, safe tool change. Four styles of collets available —"AA", "A", "D" and "E" to accommodate various tools. Adds many stations to your machines.

Consult our engineers on adapting "Magic" Quick-Change Chucks and Collets to your production problems. Send us your sketches or blue prints for recommendations and quotations.

A good stock of Quick-Change Chucks is maintained from which requirements for most sizes can be filled immediately. See pages 98-102 of Scully-Jones Catalog No. 500.

Refer to the Scully-Jones Catalog showing over 500 types and sizes of cutting tools, collet chucks, boring equipment, centers, etc.

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At one-half your cost to build, you can stock in your own tool crib any or all "27 Varieties" of Noble & Stanton's standardized Jig and Fixture Components in a full range of sizes to meet your every need—just as you stock drill jig bushings and cutting tools.

Noble & Stanton standards are preferred by those who demand the highest quality tooling.

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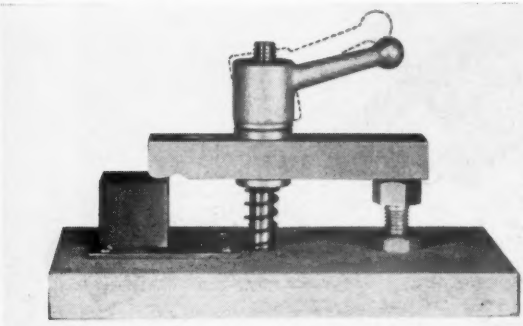
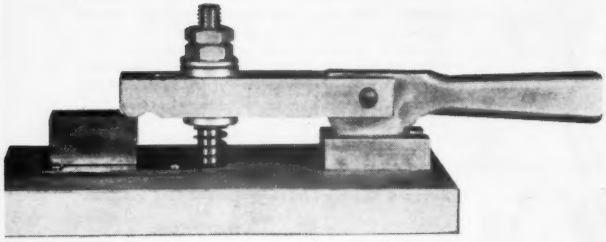
QUARTER TURN "LIGHTNING" CLAMP ASSEMBLY. Positive clamping . . . instant release . . . 1045 forged steel clamp lever . . . ground thread alloy steel stud . . . available in 27 size combinations. Ask us for free demonstration by one of our representatives. All parts properly heat treated and chrome plated.





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INDUSTRIAL DIGEST

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Science • Research • Methods • Tooling • Production • Trade News and Reports

Resistance Welding Contest Offers $2000

Announcement has been made that $2000 in cash prizes will be awarded in 1947 by the Resistance Welder Manufacturers' Association, for outstanding papers dealing with resistance welding subjects. A wide choice in subject matter is allowed.

One prize of $750 will be for the best paper from an industrial source on subject matter concerned specifically with resistance welding, but there are no restrictions on scope. A $500 prize will be given for the second best paper; $250, third best.

For the paper emanating from a university source, a prize of $300 will be awarded on the basis of the greatest original contribution to the advancement and use of resistance welding; $200 will be given for second place.

Now open, this contest will close at midnight, July 31, 1947. Minimum length requirement for papers entered in this competition is 2500 words.

Other details can be obtained by writing to the American Welding Society, 33 West 39th St., New York 18, N. Y.

Apprenticeship Programs Triple

During last year 10,756 apprenticeship programs were set up throughout American industry, from 5,818 to an all-time high of 16,574 or nearly three times the number at the end of 1945. During 1946 there was a gain of 48,125 more establishments participating in programs, from 30,628 to 78,753, or more than 2½ times the 1945 figure. In the construction industry there was an increase of 245 percent.

In the manufacturing and other industries there has been an increase of 25,055 companies participating in programs, a large percentage of which are participating in area-wide programs, while the balance have independent programs under which only the apprentices in their own plants are trained.

Since the war, every industry has had an enormous reconversion job to meet peacetime demands, and one of the major tasks has been to overcome the shortage of skilled men. During the war, apprentice-training was seriously retarded, due largely to the dearth of young men not in uniform, qualified for this training. Today industries are making up for lost time, and fully 85 percent of the apprentices currently employed are veterans.

This increase in apprenticeship programs was announced by William F. Patterson, Director of Apprentice-Training Service, U. S. Dept. of Labor.

864 ASA Standards

A list of 864 standards approved for national use of industry by the American Standards Association has been made public and is now available for general distribution.

Standards listed include definitions of technical terms, specifications for metals and other materials, methods of work and methods of test for finished products, many of which were developed under war procedure and are now approved for peacetime use. Reaching into every important engineering field, they also include standards dealing with in-

dustrial safety, industrial medicine and a wide variety of consumer goods.

These standards represent agreement of maker, seller, user and regulatory groups as to the best possible practice at the time of approval and are revised periodically to keep up with mechanical invention, developments of power and new uses of materials.

This list represents the cumulative efforts of above 3,000 men, representing 660 organizations working on the development of standards.

New Trade-Mark Law

W. H. Anderson Company, law book publishers of Cincinnati, Ohio, announce the publication of the first book on the new trade-mark act—"Trade-Mark Act of 1946," by H. A. Toulmin, Jr., of Dayton, Ohio. (Price, single copies $5.00 —10 or more copies $4.00 each.)

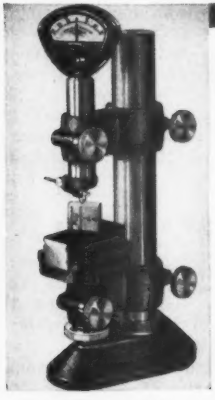
This act, known as the Lanham Act, is the first comprehensive law enacted for the protection of trade-marks in the United States. It was advocated for years by the National Association of Manufacturers, Association of National Advertisers, Inc., and the patent committees of various bar associations.

The author of this book is a well-known authority on trade-mark law and the author of previous trade-mark books and articles, and counsel for a large number of corporations on trade-mark matters. He is a member of the law firm of Toulmin & Toulmin, of Dayton, Ohio, and Washington.

Under the new law many types of trade-marks which could not be successfully protected are now susceptible of protection, such as secondary meaning marks, service marks, certification marks and distinctive package designs.

Another unique feature of the trade-mark law is the provision for separate registers. In addition to the principal and supplemental registers, the Commissioner of Patents may establish separate registers for foreign marks, service marks and collective and certification marks.

New grounds for cancellation are if the mark becomes the common descriptive name of a product or if the mark is being used to violate the anti-trust laws.



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FRICTIONLESS AMPLIFICATION

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Complete elimination of friction, lag, and backlash insures positive, dependable repeat readings. Pointer responds instantly to the slightest movement of measuring tip, no swinging past true reading, no waiting for pointer to come to rest. No lights or electro magnets, no warm-up period required. No electrical connections, can be readily moved to different locations. GRADUATED: .0001" to .00001", .001 mm to .0002 mm.

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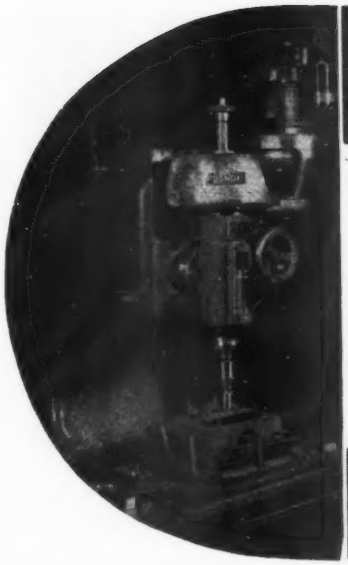

MILLING - DRILLING - BORING ATTACHMENT for Heavy Duty Operations

Photo shows Rusnok head used to convert an old type milling machine into high speed, versatile, productive equipment. Uses many types of cutters on a wide range of work. Easily mounted—tilts to any angle. Large size spindle (No. 9 B & S taper). Takes 1/16" to 3/4" end mills. Large quill with 4" travel, counter balanced, hardened and ground. Six speeds 250 to 3600 RPM. Lever and worm feeds. 1/2 h.p. motor. Specially engineered by RUSNOK to meet modern demands for high speed, high precision, heavy duty end mill operations.

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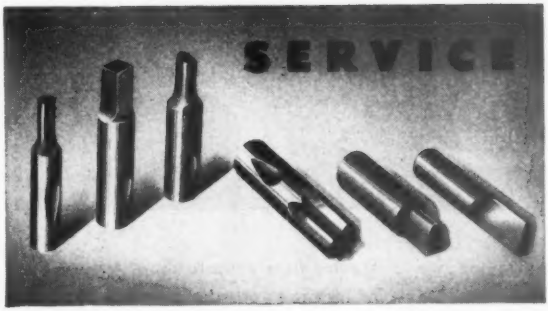

WITH A

Punch!

Allied's R-B Interchangeable Punches and Dies for the metal-working and plastics industries are *available from stock* in standard round, oblong and square shapes of almost any required size. Special shapes, such as those illustrated, are *promptly furnished* to your specifications in any size or material. Full information and comprehensive R-B Catalog on request.

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IT PAYS to REDUCE TAP BREAKAGE

Does the job in a fraction of the time required for hand tapping. Because the work is dependably straight and square, tap breakage is practically eliminated—and gone are the wasted hours of trying to pry broken taps out of dies. Equipped with seven Adaptors, ranging from 8-32 to ½", it takes care of 95% of all tapping requirements. (Taps not furnished.) $52.50 F.O.B. Minneapolis. Ask your mill supply house, or write Dahlstrom Mfg. Co., 422 South 6th St., Minneapolis 15, Minn.

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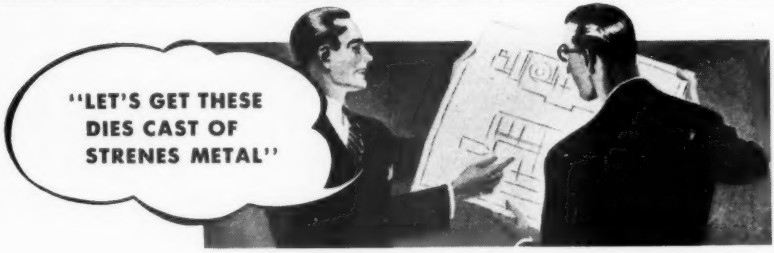
- 12" x 6" x 14"
- Fastens to wall or bench
- Anyone can operate it



"When I worked in Dayton, we used ***Strenes Metal*** cast dies for refrigerator tops and doors. Saved a lot of time and cost on tooling up. And we got longer runs between re-dressings."

That's the way the good word about ***Strenes Metal*** cast dies has spread from shop to shop. A number of instances are shown in our picture book titled "*Strenes Metal Castings.*" A copy is yours for the asking. Write us now while you're thinking about it.

Strenes Metal
DRAWING AND FORMING DIES

THE ADVANCE FOUNDRY CO., Dayton 3, Ohio

TDJ SHOP DATA SHEET NO. 59

Thrust Loads Due to Drilling Various Metals

Drill Size	CAST IRON — Feed in Inches per Revolution					MACHINE STEEL — Feed in Inches per Revolution				
	.001	.005	.010	.015	.020	.001	.005	.010	.015	.020
1/16	20	74	128	177	223	42	128	207	274	335
5/32	27	98	170	235	296	55	170	275	364	445
1/8	33	120	208	288	362	68	207	336	445	544
3/16	44	159	276	382	481	90	275	446	591	723
1/4	54	194	338	467	588	110	337	546	723	884
5/16	63	227	395	546	688	128	394	638	846	1035
3/8	71	258	449	621	781	146	447	725	961	1175
7/16	79	287	500	692	871	163	498	807	1070	1310
1/2	87	315	549	759	956	179	547	886	1175	1435
9/16	95	342	596	825	1040	194	594	962	1275	1560
5/8	102	369	642	888	1115	209	640	1035	1375	1680
11/16	109	394	686	949	1195	223	684	1105	1470	1795
3/4	116	419	729	1010	1270	237	727	1175	1560	1905
13/16	122	443	771	1065	1340	251	768	1245	1650	2015
7/8	129	467	812	1125	1415	264	809	1310	1740	2125
15/16	135	490	852	1180	1485	277	849	1375	1825	2230
1	141	512	892	1235	1550	290	889	1440	1910	2330
1 1/8	154	556	968	1340	1685	315	965	1565	2075	2535
1 1/4	165	599	1040	1440	1815	339	1040	1685	2230	2725
1 3/8	178	640	1115	1540	1940	362	1110	1800	2385	2915
1 1/2	188	680	1185	1640	2060	385	1180	1910	2535	3100
1 5/8	199	720	1255	1730	2180	407	1250	2020	2680	3275
1 3/4	209	758	1320	1825	2295	429	1315	2130	2825	3450
1 7/8	220	795	1385	1915	2410	450	1380	2235	2965	3620
2	230	832	1450	2005	2520	471	1445	2340	3100	3790
2 1/4	249	904	1575	2175	2740	511	1570	2540	3370	4115
2 1/2	268	973	1695	2340	2950	551	1690	2735	3625	4430
2 3/4	287	1040	1810	2505	3150	589	1805	2925	3875	4735
3	305	1105	1925	2660	3350	626	1915	3105	4120	5030
3 1/2	340	1230	2145	2965	3730	697	2135	3460	4590	5605
	CAST STEEL					CARBON STEEL				
1/16	29	96	161	219	271	50	146	233	306	371
5/32	38	127	214	291	360	66	195	310	406	492
1/8	47	156	262	356	440	81	238	379	497	602
3/16	62	207	348	472	585	108	316	503	660	800
1/4	76	253	425	578	715	132	387	615	807	978
5/16	88	296	497	675	836	154	452	719	943	1145
3/8	101	336	565	767	950	175	513	817	1070	1300
7/16	112	374	629	855	1060	195	572	910	1195	1445
1/2	123	411	691	938	1160	214	628	999	1310	1590
9/16	134	446	750	1020	1260	232	682	1085	1425	1725
5/8	144	480	808	1095	1360	250	734	1170	1530	1860
11/16	154	514	864	1170	1450	267	785	1250	1640	1985
3/4	163	546	918	1245	1545	284	834	1325	1740	2110
13/16	173	577	971	1320	1630	300	882	1405	1840	2230
7/8	182	608	1020	1390	1720	316	929	1475	1940	2350
15/16	191	698	1075	1455	1805	332	975	1550	2035	2470
1	200	668	1125	1525	1890	347	1020	1620	2130	2580
1 1/8	217	725	1220	1655	2050	377	1110	1760	2310	2805
1 1/4	233	780	1310	1780	2205	406	1190	1895	2490	3020
1 3/8	250	834	1400	1905	2360	434	1175	2030	2660	3225
1 1/2	265	887	1490	2025	2510	461	1355	2155	2830	3430
1 5/8	280	938	1575	2140	2650	487	1435	2280	2990	3625
1 3/4	295	988	1660	2255	2795	513	1510	2400	3150	3820

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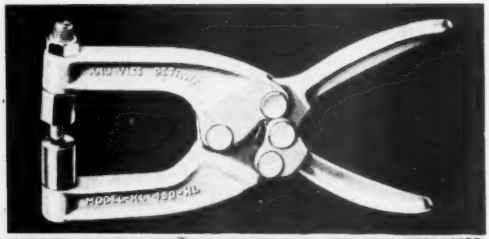
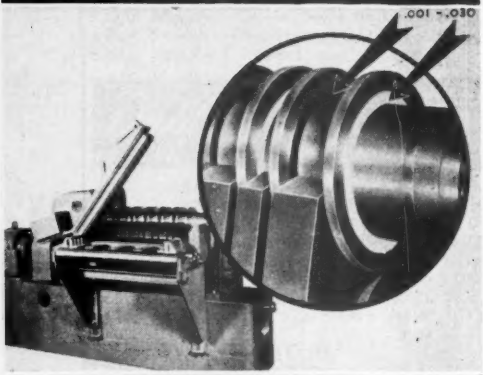
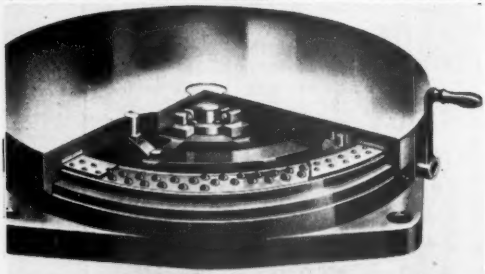






FOR FURTHER INFORMATION FILL IN KEY NUMBERS ON POSTAGE-FREE INFORM-A-GRAM INSERT

QUICKLY ALIGNING AND POSITIONING several sheets of metal for riveting, welding or drilling, the new Knu-Vise hole locator operates as simply as pliers. Its toggle action of 500 lbs holding pressure automatically locks upon the work and frees the operator's hands for other operations. Work locating pins, 1¼" clamping capacity, and quick release make this a time and effort saving tool. Write for further information to KNU-VISE, INC., Dept. 6-49, Detroit, Mich., or use INFORM-A-GRAM Key No. 649-V.

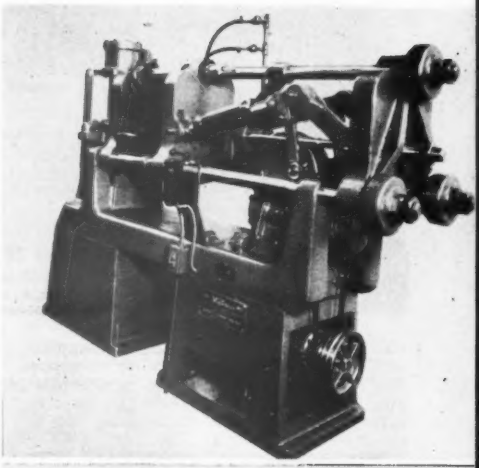
A COMPLETE RANGE OF SIZES of Arbor Spacers and Shim Stock for use on slitting machines is now available from Industrial Products Suppliers. Colored for easy thickness identification, these spacers are produced in plastic at much lower cost than metal, though they do their job just as well. Inquire further from INDUSTRIAL PRODUCTS SUPPLIERS, Dept. 5-94, 108 Water St., New York 5, N. Y., or use INFORM-A-GRAM Key No. 594-V.

LOCATING AND LOCKING AUTOMATICALLY, the new Robbins Index Table employs a specially designed peripheral ball-bearing which prevents out-of-parallel conditions due to off-center cutting or work loads, and insures effortless indexing. Index positions to suit any job, ribbed table and base, hardened and ground (and dirt-protected) wearing parts, non-brinelling bearing races, are additional design and working features. Send for additional data to ROBBINS ENGINEERING CO., Dept. 6-17, 318 Midland Ave., Detroit 3, Mich., or use INFORM-A-GRAM Key No. 617-V.

QUICKLY EXPELLING AIR from pneumatic cylinders, the new Mead exhaust valve acts on the principle of a bellows, automatically opening as soon as the air supply is shut off. Attached directly to the air cylinder, or to the air hose adjacent to the cylinder, the valve has been proved to obtain an increase of 67 percent in strokes per minute. Complete details may be requested from MEAD SPECIALTIES CO., Dept. E. V. 32, 4114 No. Knox Ave., Chicago 41, Ill., or use INFORM-A-GRAM Key No. 569-V.

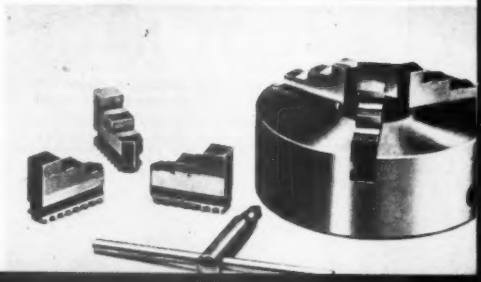
ON PARADE

FOR THE PRODUCTION OF ZINC, lead and tin die castings, the new fully automatic low cost die casting machine recently announced by Light Metal Machinery Co. features a patented cycling mechanism which provides for automatic die movement, shot and ejection in continuously repetitive cycles. Doubling hourly production as it saves up to 90 percent die costs, the "Work Horse" provides a wide range of casting sizes, and operates at 240, 330, 520 and 720 shots per hour. Shot capacity of the machine is 16 ounces, with a casting area of 30 square inches. Offering 15-minute die changes; greater dimensional accuracy; 50% space savings; low cost and rapid maintenance, this machine is described with full details about its operation, and descriptions of typical castings, in the new booklet, "Fully Automatic Die Casting with the Work Horse," which may be requested from LIGHT METAL MACHINERY CO., INC., Dept. 49, 740 Penton Building, Cleveland, Ohio, or use INFORM-A-GRAM Key No. K49-V.



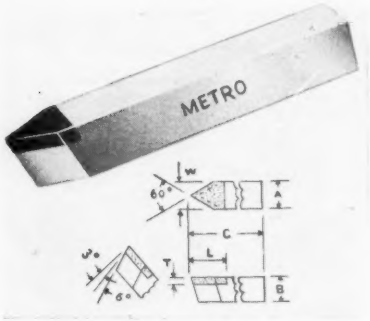
FEATURING A PRESSURE CONTROL to relieve a thread inspector of the difficult responsibility of judging questionable cases, the new Model C Roll Thread Comparator gives light signals for full "go" and "no go" functional check on pitch diameter, minor diameter, lead and angle. This instrument is especially recommended for builders of fine instruments and related industries when screws of diameters ranging from .060" to .216" and threads of 80 to 28 per inch National Form 60° must be inspected. Additional data will be sent upon request from PRATT & WHITNEY, DIV. NILES-BEMENT-POND COMPANY, Dept. 4-30, West Hartford, Conn., or use INFORM-A-GRAM Key No. 430-V.

UNUSUAL FEATURES FOR A 5" LATHE CHUCK are included in the Universal 5U, three-jaw design. Constructed with three hardened alloy pinions and threaded to mount directly on all 1½" eight-spindle thread lathes, this inexpensive chuck also can be adaptor mounted to others. It has two sets of interchangeable jaws for better internal and external grip. Get other material from FALLS PRODUCTS, INC., Dept. 48, Box 305, Genoa, Ill., or use INFORM-A-GRAM Key No. K48-V.



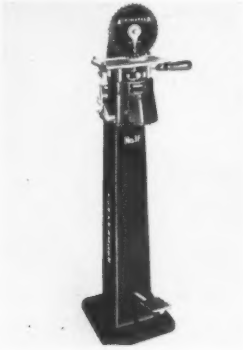
PROGRESS ON PARADE

PARTICULARLY SUITABLE FOR LONG RUN THREADING OF STEEL PARTS, Metro Tool and Gage Co. offers a new line of tough, wear-resistant Standard Carbide Tipped Threading Tools. Style M-15 tools are of the



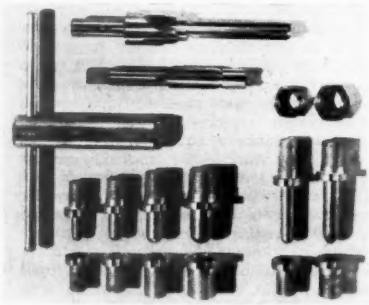
60° V-nose type with a primary clearance of 3° at the nose and a secondary clearance of 6°. Further data is available upon request from METRO TOOL AND GAGE CO., Dept. 9, 4240 W. Peterson Ave., Chicago 30, Ill., or use INFORM-A-GRAM Key No. 9-V.

OFFERING SIMPLE ADJUSTMENT FOR LETTER THICKNESS AND SPACING, and increasing foot power operation from six to eight times, the improved design of Model IF Acromarker Name Plate Stamping Machine



includes an enlarged cast iron pedestal for additional sturdiness. The marking dies are machine engraved, hand finished and carefully checked for perfect alignment. Additional data may be requested from THE ACRO-MARK CO., Dept. 6-36, 5-15 Morrell St., Elizabeth, N. J., or use INFORM-A-GRAM Key No. 636-V.

INSERTED MORE EASILY, QUICKLY, AND ACCURATELY, the new Master Sure-Lock Dowel features a new type shoulder and taper fit of body to keep the dowel anchored tightly. A new type wrench of hardened steel permits the dowel to be firmly tightened without stripping. Descriptive literature show-



ing diagrams and charts of sizes is offered by KINDT-COLLINS CO., Dept. 74, 12651 Elmwood Ave., Cleveland, Ohio, or use INFORM-A-GRAM Key No. D74-V.

A PERFECTLY GROUND SPIRAL POINT can be turned out quickly by an unskilled operator on the new Blake Flute Grinder. It provides the positive, mechanical controls necessary for the accurate, speedy and easy sharpening of both the spiral points and the straight flutes of taps as well as countersinks and drills. Regardless of operating without

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IDEAL FOR BUSY TOOL ROOMS

Here is a compact Miller and Jig Borer that does fast, accurate work on small dies, jigs, fixtures, patterns and models . . . economically. No need to tie up large machines having higher rated capacities. Saves time because setup is rapid and changeover easy.

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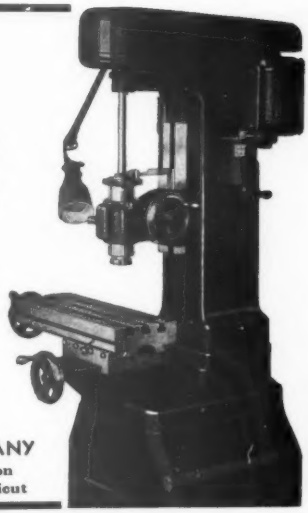

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With Dickerman Hitch Feeds for your punch presses, you'll get top production at rock-bottom cost. They are accurate, reliable and easily changed from one die to another. Send now for descriptive booklet.

DICKERMAN HITCH FEEDS

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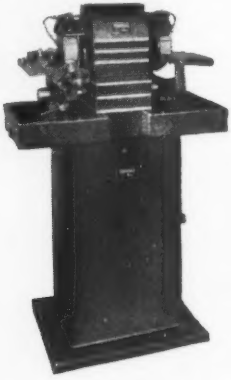
coolant, grinding dust is thrown downward into the easily removable coolant collector pan. The standard machine can handle right- and left-hand taps from the smallest up to ⅝" tap diameter, inclusive, and under certain conditions, taps of much larger diameter. Descriptive literature is available by writing EDWARD BLAKE CO., Dept. 79, 634 Commonwealth Ave., Newton Centre, Mass., or use INFORM-A-GRAM Key No. 79-V.

INVALUABLE FOR GRINDING CARBIDE TIPPED TOOLS and other type tool bits requiring keenest cutting edges and extreme accuracy, Willey's Model 50-A grinder has bronze bearing trunnions which support the tool rest table ¾" below work cutter, permitting grinding tools from 3/16" to ¾" square without further horizontal adjustment —a Willey's feature that speeds production.



Complete specifications and information are available from WILLEY'S CARBIDE TOOL CO., Dept. 5-51, 1340 W. Vernor Highway, Detroit 1, Mich., or use INFORM-A-GRAM Key No. 551-V.

MOUNTED WITH SAPPHIRE WEARING SURFACES, the spindle and anvil tips of the Tu-Mi-Co Tubular "Feather Touch" Microm-

eters make a precision instrument which after 2,000,000 readings still appears without wear. This "ST" series is available in 1", 2", and 3" sizes. Get other details from TUBULAR MICROMETER CO., Dept. TD, St. James, Minn., or use INFORM-A-GRAM Key No. B91-V.

WITH AN OVERALL BEZEL DIAMETER OF ONLY 1¼", the new Federal Products "A" size Dial Indicators can be used when there is not enough space for a large indicator,

when the gage is portable, or weight is a factor. These incorporate the same Low Friction Full-Jeweled features as the regular size Federal indicators and give repetitive accuracy. Further details about this "A" size dial indicator will be sent upon request from FEDERAL PRODUCTS CORP., Dept. 4, 1144 Eddy St., Providence, R. I., or use INFORM-A-GRAM Key No. 4-V.

TWO NEW DUCTILITY TESTING MACHINES (cup test), model PA-2 with a 15,000# capacity for stock up to ⅛" in thickness and model PA-3 with a 30,000# capacity for stock up to ¼" thickness, are announced by Steel City

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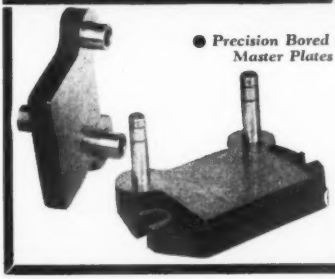
DANNEMAN Precision DIE-SETS



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Testing Laboratory. The specimen is automatically held between grips with a load in proper proportion to the one being applied in forming the cups. Specifications and data are available from STEEL CITY TESTING LABORATORY, Dept. 79, 8843 Livernois Ave., Detroit 4, Mich., or use INFORM-A-GRAM Key No. E79-V.

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STREAMLINED DESIGN, EASY READABILITY, AND SHOCK ABSORBING MOVEMENT, are features of the new line of Dayton

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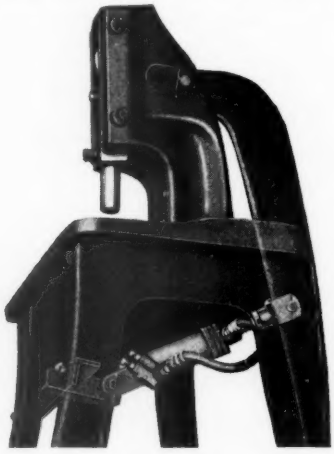
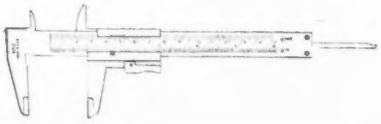
ANY KICK PRESS CAN BE CONVERTED to power operation by the "Packaged" Pneumatic Equipment Unit (Kit DC-39950) designed by National Pneumatic Co. Use of this power unit increases press production through the effortless, controlled speed of the stroke. Quality of work is also improved since every stroke of the press is delivered at the same uniform power. Fully descriptive Bulletin No.



DC-26 is available upon request from NATIONAL PNEUMATIC CO., Dept. 71, 420 Lexington Ave., New York 17, N. Y., or use INFORM-A-GRAM Key No. G71-V.

ACCURATELY DETERMINING INTERNAL AND EXTERNAL dimensions, thread and depth measurements, the AMIC Quick Action Vernier Caliper does the job of three different tools. Scientifically engineered and machined,



this instrument has accurate machine divided and etched graduations. Further description is given in new literature now available from AMERICAN MEASURING INSTRUMENTS

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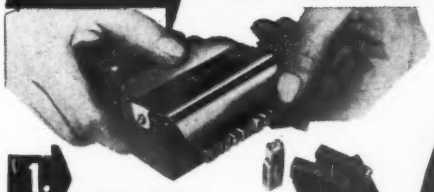
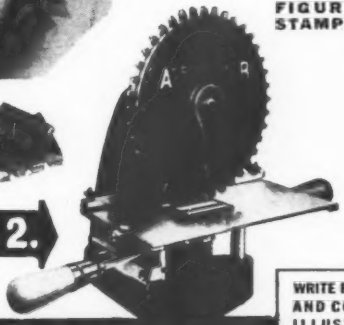


1. HERCULES HOLDER AND TYPE



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A SINGLE, DUAL PURPOSE UNIT, suitable for both induction and dielectric heating operations, the recently developed Ther-Monic M-285C Electronic Heating Generator is provided with two separate, interchangeable oscillator sections, for metal and non-metal heating. With its flexibility of application, rapid and dependable source of heat, and efficiency of heating non-conductive materials, it meets the needs of all laboratories. Write to the INDUCTION HEATING CORP., Dept. 96, 389 Lafayette St., New York 3, N. Y., or use INFORM-A-GRAM Key No. J96-V.

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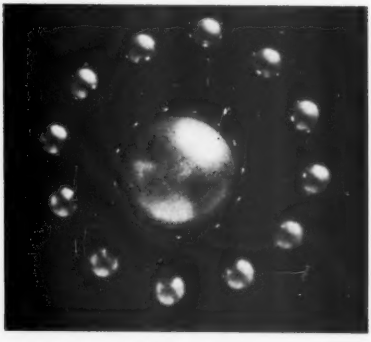

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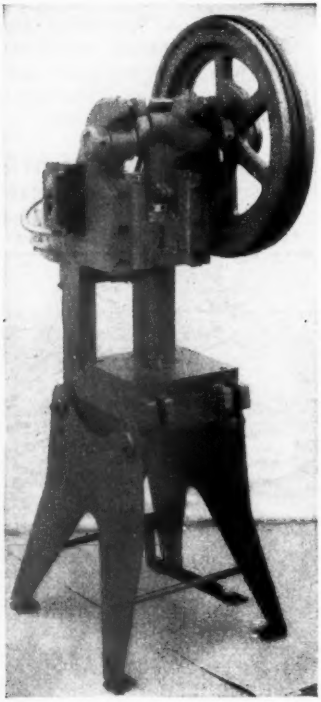

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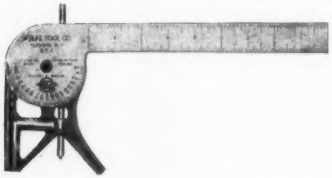
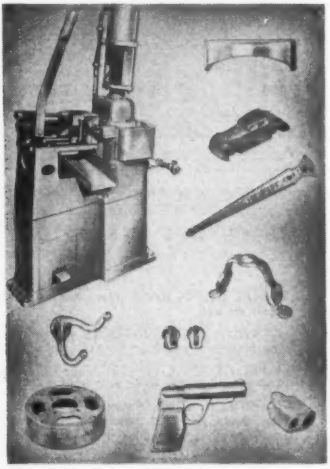
time, the new "Center-finder" protractor has a 0°-90°-0° scale, together with a double-reading of ½" per foot pitch scale; also



serves as a 360° protractor. For full information write to INTERSTATE SALES CO., Dept. 31, 1121 Broadway, New York 10, N. Y., or use INFORM-A-GRAM Key No. K31-V.

DESIGNED SPECIFICALLY FOR MANUFACTURING SMALL PARTS at high rates of speed (up to 1500 shots per hour with single cavity



molds), a new model low cost air operated die casting machine has been announced by the D C M T Sales Corp. With the machine is included engineering services of die designing, die making, field and production engineering. Further technical literature may be requested from D C M T SALES CORP., Dept. 48, 315 Broadway, New York 7, N. Y., or use INFORM-A-GRAM Key No. J48-V.

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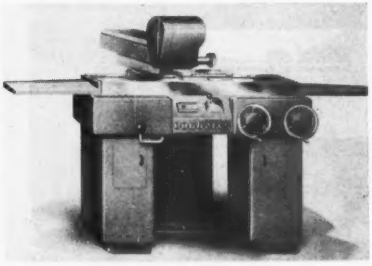

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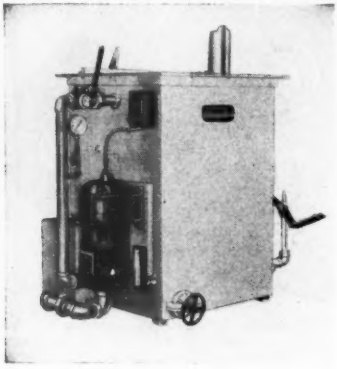

which can be set on the floor; no pit or cement work is necessary. All washing operations requiring several steps can be performed or it can be used individually. Spray nozzles are adjustable and replaceable. Additional information is available upon request from OPTIMUS EQUIPMENT CO., Dept. 99, Church St., Matawan, N. J., or use INFORM-A-GRAM Key No. D99-V.

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Model W-10, 10" Wet Carbide Tool Grinder — one of a complete line including Chip Breaker Grinders.

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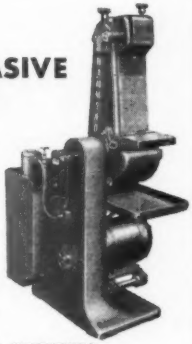
Model VH-6, 6" Wet-N-Dri Abrasive Belt Grinder, vertical or horizontal — one of many types and sizes.



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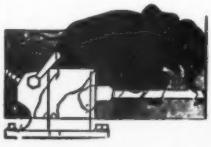

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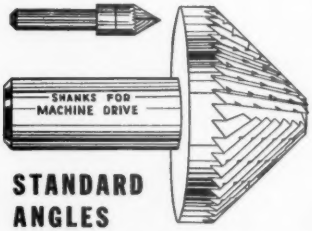

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FROM STOCK BLANKS

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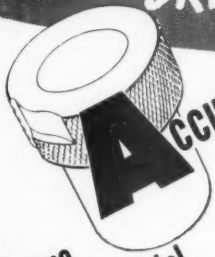

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GRINDING OR DUPLICATING THE CUTTING EDGE of taps, counterbores, end mills, milling cutters, and reamers can be done by even inexperienced operators in only a few minutes with the Cleveland Universal Indexing Head. Able to rotate 360 degrees in three planes, the head incorporates positive locking devices which will hold the tool at any angle in relation to the grinding surface. Complete literature with diagrams and technical data is available from GRINDERS & FIXTURES, INC., Dept. 82, 1255 West 4th St., Cleveland 13, Ohio, or use INFORM-A-GRAM Key No. A82-V.

DELIVERED READY FOR USE IN THE MACHINE SHOP, in a garage, or on the farm, the Men-E-Uses Power Drive has a speed range of 20 to 750 rpm and with the addition of the auxiliary shaft, rates 4 rpm to 750 rpm. Giving shaft rotation in both right and left direction by mounting the motor on either side of the base, this speed reducer is fully described in new literature available from THE FLINCHBAUGH CO., Dept. 34, York, Pa., or use INFORM-A-GRAM Key No. K34.5-V.

COMPLETELY FINISHING HOLES TO CLOSE TOLERANCES, midget solid carbide grinding wheels from .030" to 0.250" have been developed by the newly organized Raymac Co. These small carbide wheels will remove metal of any hardness, including Stellite, and permit maximum cutting with no distortion or tapering of holes. Also producers of small carbide reamers, burrs and special wheels and tools, RAYMAC CO., Dept. 45, 3729 Cass Ave., Detroit, Mich., offers a three-color explanatory folder, or use INFORM-A-GRAM Key No. K45-V.

UNEXCELLED FOR GRINDING into grooves and corners, large radii and castings, Bayflex Raised Hub Disc wheels are showing long life on thousands of jobs. Flat surface and edge can be used for grinding and the edge can also be used for cutting off. Standard stock sizes with list price are given in literature available upon request from BAY STATE ABRASIVE PRODUCTS CO., Dept. 2-05, Westboro, Mass., or use INFORM-A-GRAM Key No. 205-V.

COMPLETELY ELIMINATING WRENCHES, NATCO automatic clamping reduces operator fatigue as is improves accuracy and safety. For fixtures in connection with automatic

processing machines on drilling and tapping operations, this automatic handling is explained in a new 12-page, three-color booklet giving vivid views of NATCO machines and brief explanations of their job capacities and specifications. Request copies from NATIONAL AUTOMATIC TOOL COMPANY, INC., Dept. 69, Richmond, Ind., or use INFORM-A-GRAM Key No. E69-V.

CONTINUOUSLY IMPROVING ITS LINE OF POLISHING LATHES, to meet the high production requirements of polishing, buffing and brushing operations, the Hammond Machinery Builders Inc. has just issued their new Catalog No. 55 describing recent improvements. Abra-

sive belt machines, employing factory coated abrasive belts for grinding and finishing of metals, buffing, brushing and deburring machines (air operated) are also described. Complete details on the above products and their cylindrical finishing machine are available in Catalog No. 55 which will be sent upon request from HAMMOND MACHINERY BUILDERS, Dept. 95, 1631 Douglas Ave., Kalamazoo 54, Mich., or use INFORM-A-GRAM Key No. 95-V.

CAST IN HIGH GRADE CAST IRON AND SEMI-STEEL, Tri-Parts Supply Co.'s fixture handles are submitted to a special tumbling process after gates and burrs are ground off, leaving a smooth finished surface for painting or spraying with a minimum of hand work. Wheels, straight type with machined and dish type rims and six pointed Hand Knobs are of cast iron, sand blast finished and ground to rigid inspection. Price list and data are available from TRI-PARTS SUPPLY CO., Dept. 47, 1228 Racine St., Racine, Wis., or use INFORM-A-GRAM Key No. K47.5-V.

PROVIDING VERTICAL ADJUSTMENT FOR BORING TOOLS in lathes, the Bokum Tool Holder is brought to a precision setting by a conveniently located screw and positively locked. All parts are made of heat treated alloy steel. A well-illustrated brochure is available upon request from the BOKUM TOOL CO., Dept. 43, 14775 Wildemere Ave., Detroit 21, Mich., or use INFORM-A-GRAM Key No. A43-V.

SYMMETRICAL IN DESIGN, with operating handles and levers in positions that will appeal to the operator for successful performance, the Springfield precision lathe gives maximum production value. All features and dimensions are very liberal in order that the machine will perform on work normally considered too heavy for regular 20" lathes. Bulletin No. 159 gives detailed information on headstock, compound rest, tailstock, taper attachment, apron and carriage and specifications. Write THE SPRINGFIELD MACHINE TOOL CO., Dept. 6-47, Springfield, Ohio, or use INFORM-A-GRAM Key No. 647-V.

"DIE-LESS DUPLICATING" is a new industrial technique made possible by the extreme accuracy, adaptability and ease of operation of Di-Acro Precision Machine, bender, brakes and shears. Precision parts and pieces can be quickly fabricated by this practical system eliminating dies for experimental as well as quantity run duplicating operations. Complete information, table of operating capacities and data are available from O'NEIL-IRWIN MFG. CO., Dept. 20, Lake City, Minnesota, or use INFORM-A-GRAM Key No. 20-V.

QUICK-ACTION VERNIER CALIPER, perfect tool for machine shop, garage, maintenance, or home workshop. Three tools in one; external and internal dimensions, exact thread measurements, and depth measurements. Made of stainless steel, machine divided and etched graduations with the same accuracy as on expensive precision calipers. Sizes and prices are listed in literature available upon request from AMERICAN MEASURING INSTRUMENTS CORP., Dept. 1-86, 240 West 40th St., New York, N. Y., or use INFORM-A-GRAM Key No. 186-V.

RECOMMENDED FOR CUTTING ALUMINUM, magnesium, steel and even plastics, plywood and other non-metallic materials, Grobet's new line of twin fluted countersinks produce an exceedingly smooth and precise finish. Guaranteed against chatter marks with perfect chamfers free from ridges and scores. For complete information on these fast cutting precision tools write GROBET FILE CO., Dept. 7-05, 421 Canal St., New York 13, N. Y., or use INFORM-A-GRAM Key No. 705-V.

CLOSE TOLERANCE AND FINE SURFACE FINISH production problems can be successfully solved by Sunnen honing stones, mandreis, honing heads and accessories. New mandrels and stone types are now available for a variety of honing jobs, while diameter ranges and honing depths have been extended in the various mandrel types. Supply catalog No. X-SP5050 contains complete information on industrial honing accessories with a concise guide for selection of the necessary parts for any particular honing job and an Interlocking Part numbering system. Write to SUNNEN PRODUCTS CO., Dept. 5-83, 7947 Manchester Ave., St. Louis 17, Mo., or use INFORM-A-GRAM Key No. 583-V.

SELF-INDEXING ENCO HEXTURRET, designed for heavy as well as normal work, provides a wide range of uses for operations generally done with the hex turret on a turret lathe or screw machine. Double heavy duty gibs maintain constant accuracy, even after long usage. Catalog "30 Models" describes Enco Lathe Turrets for bench, engine, turret lathes and screw machine. Write to ENCO MFG. CO., Dept. 30, 4522-24 W. Fullerton Ave., Chicago 39, Ill., or use INFORM-A-GRAM Key No. B30-V.

RAPIDLY AND EASILY PRODUCING the high polish and precision flat plane necessary for sliding and rotating parts, air and liquid tight seals, flat surfaces of plastic molds, etc., the Spitfire Flat Lapping Machine can obtain a surface finish as fine as 2 rms micro-inches. Single pieces usually require no holders, chucks, or collets, but are held on the revolving lapping plate by the operator who also directs the motion. For more complete information, write to SPITFIRE TOOLS, INC., Dept. 98, 2933 Pulaski Rd., Chicago 41, Ill., or use INFORM-A-GRAM Key No. E98-V.

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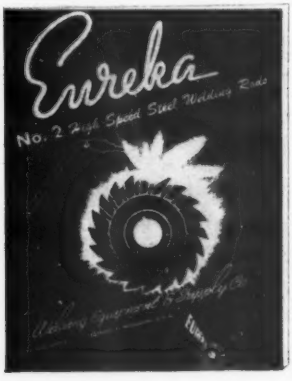
FIFTEEN DIFFERENT ACCURATE TIME-SAVING APPLICATIONS of the Lassy V-Block Angle Iron are illustrated and discussed in the recently issued Lassy brochure. Scientifically designed, this tool can replace many special custom made jigs and fixtures. Along with its versatile accessories, it is carefully encased in a sturdy mahogany case for perfect protection. Get the new literature upon request from LASSY TOOL CO., Dept. 22, Plainville, Conn., or use INFORM-A-GRAM Key No. D22-V.

FILLING THE NEED FOR AN INEXPENSIVE COLLET to cover sizes used only occasionally, the new line of precision draw-in brass collets announced by South Bend Lathe Works have many practical features. Rendering good service, these collets can be rebored to a larger diameter when worn and can be machined for holding tapers or irregular shapes. Though designed for use with South Bend Lathes, these collets are available in four styles and may be used with any machine they fit. Complete information and specifications are in Bulletin 83, available from SOUTH BEND LATHE WORKS, Dept. 5-64, 391 E. Madison St., South Bend 22, Ind., or use INFORM-A-GRAM Key No. 564-V.

WITH ONE SET OF INTERCHANGEABLE PARTS and a Hovis Master Die, the production of any size washer up to the capacity of the die is quickly and easily possible. Available in five sizes, the Master Die and its matching set of parts are clearly discussed in literature which will be sent upon request by HOVIS SCREWLOCK CO., Dept. 1-35, 8100 E. Nine-Mile Rd., Van Dyke, Mich., or use INFORM-A-GRAM Key No. 135-V.

WELDING PROCEDURES FOR REPAIRING HIGH SPEED STEEL CUTTING TOOLS, for compositely fabricating cutting tools, and for creating cutting, wearing and bearing surfaces are all carefully outlined in new literature covering Eureka No. 2 High Speed Steel Welding Rods. Well illustrated and giving the physical properties, heat treatment and uses of Eureka No. 2, the available brochure may be requested from WELDING EQUIPMENT & SUPPLY CO., Dept. 5-80, 223 Leib St., Detroit 7, Mich., or use INFORM-A-GRAM Key No. 580-V.



RECENTLY ADDED TO THE LINE of low-temperature welding and brazing alloys and fluxes carried by All-State are two new types of nickel-silver welding rods. One of these is especially recommended for production and fabrication of light steel and nickel alloy sections and for low-temperature welding of steel, stainless steel, copper-nickel and nickel; the other is to be used wherever resistance to frictional wear is desired and for work on worn or broken parts. Get further details about these new rods from ALL-STATE WELDING ALLOYS CO., Dept. 66, 96 West Post Rd., White Plains, N. Y., or use INFORM-A-GRAM Key No. K66-V.

CAPABLE OF FORMING ANY ANGLE, in addition to many inside and outside radii, the Gem-Flex wheel and tool dressing fixture also can handle drilling and light milling work easily. Only needing to know how to read dials, even an inexperienced operator can duplicate tool forms exactly while he is stepping up job efficiency, speed and quality with this versatile tool. Get literature, including photographs of the Gem-Flex at work, from ALLIED MACHINISTS OF WALTHAM, Dept. 67, 6 Water St., Waltham, Mass., or use INFORM-A-GRAM Key No. K67-V.

WHEREVER "SHOCK PROOF" ROTARY POWER IS NEEDED, where constant stopping and starting, braking or reversals of rotation are encountered, Hydraulic Drive is the answer. The Denison Engineering Co. has a new improved line of fluid motors which are fully illustrated in catalog FM-1-1. Denison high pressure, high volume Hydroilic pumps of the 3500 series are discussed in bulletin 124, available from the DENISON ENGINEERING CO., Dept. 2-60, 1197 Dublin Rd., Columbus 16, Ohio, or use INFORM-A-GRAM Key No. 260-V.

PREFABRICATED HIGH-CARBON TOOL STEEL from 1/64" to 1" and in widths of ¼" to 10", Marshall steel is precision ground to plus or minus .001". For volume tool, machine or special requirements, Marshall steel is three steps closer to the finished product with big savings. Price and size lists are available by writing MARSHALL STEEL, Dept. 41, 228 N. LaSalle St., Chicago, Ill., or use INFORM-A-GRAM Key No. K41-V.

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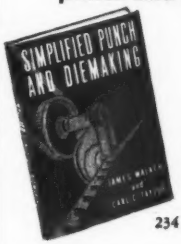

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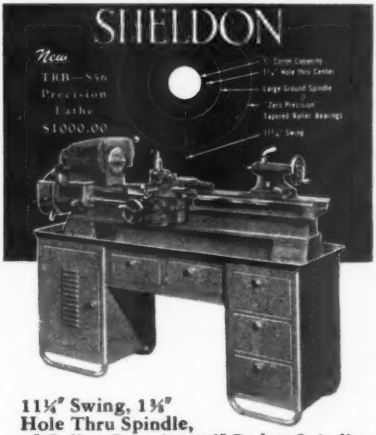

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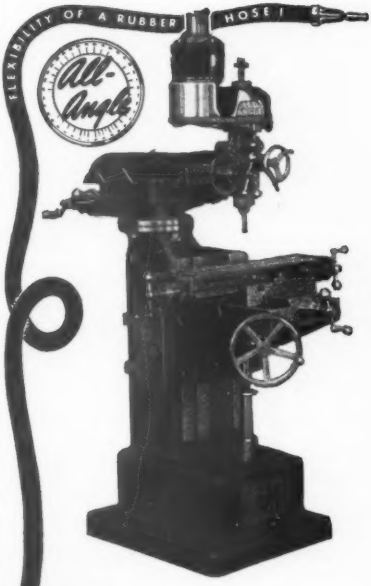

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in a folder issued by Johnson Mfg. Corp. A low cost machine that does most of the cut-off work done on high cost equipment. General specifications are also given. Copies may be requested from JOHNSON MFG. CORP., Dept. 6-48, Albion, Mich., or use INFORM-A-GRAM Key No. 648-V.

SUITED TO A WIDE RANGE OF WORK: blanking, forming, perforating, drawing and many others, the U. S. No. 1 punch press has many features which greatly increases its general use and utility. All steel frame, bronze bearings throughout and sliding key clutch of tough alloy steel are among some features listed in literature available from U. S. PRESS & TOOL CORP., Dept. 60, Chicago, Ill., or use INFORM-A-GRAM Key No. K60-V.

A NEW METHOD OF HOLDING AND POSITIONING bench work allows complete accessibility to the workpiece. Floating Ball Hydraulic "Powrarm" has finger tip control with a large ball bearing permitting the work to be turned to any position or angle desired. Specifications of various models and attachments to suit a particular need are available from THE GARFIELD ENGINEERING CORP., Dept. 62, Kansas City 6, Mo., or use INFORM-A-GRAM Key No. H62-V.

A MODERN SKIN-TIGHT PROTECTIVE COATING. Plastic Seal, which is adaptable for product packaging, insures against rust, corrosion and physical damage. Plastic Seal will not break or crack, can be applied by merely dipping into molten material and removing almost instantly. To remove, simply slit and peel. Send for further details to PROGRESSIVE SYSTEMS, INC., Dept. 62, 2534 Elston Ave., Chicago, Ill., or use INFORM-A-GRAM Key No. K62-V.

OPERATING 50 TO 60 PERCENT FASTER than regular drills, Willey's solid carbide drills in addition, hold their size and cutting edge many times as long, increasing production and lowering down time. Send for folder containing specifications and prices on straight shank drills. Write WILLEY'S CARBIDE TOOL CO., Dept. 5-51, 1342 W. Vernor Highway, Detroit 1, Mich., or use INFORM-A-GRAM Key No. 551-V.

BROACHING NEWS FROM COLONIAL BROACH CO. brings news of a new broach sharpener which features making the job easier for the operator; a dual ram machine which completely machines the big ends of automobile connecting rods; and an air operated eccentric fixture which simplifies broaching of steering knuckles. For detailed information write COLONIAL BROACH CO., Dept. 26, P.O. Box 37, Harper Station, Detroit 13, Mich., or use INFORM-A-GRAM Key No. 26-V.

AGAIN AVAILABLE FOR GENERAL USAGE. Swedish Gage Co. precision micrometers announce their postwar return in a new, well-illustrated catalog. Discussing their hardened, ground and lapped lead screw, three definite guaranteed ranges of accuracy and positive spindle lock, the catalog also gives specifications and price lists. A section is devoted to other Swedish Gage precision products. Request this catalog from SWEDISH GAGE CO., Dept. 85, 8900 Alpine Ave., Detroit 4, Mich., or use INFORM-A-GRAM Key No. B85-V.

WAYS TO SAVE TIME AND STORAGE SPACE with pallet load construction and pallet lift trucks are discussed in new Lyon-Raymond literature. Available for Single- or Double-face pallets, these hydraulically operated trucks give easy, smooth handling, through finger-tip control. Clear diagrams of the truck and a suggested type of pallet are included in Bulletin 220 available from LYON-RAYMOND CORP., Dept. 3-74, Greene, N. Y., or use INFORM-A-GRAM Key No. 374-V.

BUILT ESPECIALLY FOR INDUSTRIES REQUIRING PRECISION PRODUCTION of small holes in parts of miniature dimensions, the Hamilton "A M" Super Sensitive Drilling Machine is rugged, accurate and super-sensitive. Simply constructed and economically maintained, this machine will accurately keep to the same production load (within its own size limitations of 16" x 7" x 25") as larger machines. Get full specifications and details in literature available from HAMILTON TOOL CO., Dept. 61, 9th St. & Hanover, Hamilton, Ohio, or use INFORM-A-GRAM Key No. G61-V.

ONLY THREE MOVING PARTS, each easily accessible for servicing, make the Air-O-Chek air gun leak-proof, and operated by only a slight pressure between the thumb and finger. Shutting off positively upon release, the Air-O-Chek patented device employs an enclosed lever connected to the valve by a ball and socket joint. Full details, including complete illustrated listing of six air-gun models and attachments, may be requested from AIR-WAY PUMP & EQUIPMENT CO., Dept. 12, 569 W. Van Buren St., Chicago, Ill., or use INFORM-A-GRAM Key No. F12-V.

A DEPENDABLE, LOW-PRICED UNIT for the application of powdered Colmonoy alloys, the new Spraywelder assures perfect results from the exclusive Colmonoy Sprayweld process. This process combines the advantages of both welding and metallizing practice to render a surface that is dense, hard wearing, corrosion resistant and completely bonded to the base metal. Complete details, illustrations and explanations of the Colmonoy Sprayweld Process and equipment are carefully given in new literature which may be

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BY ADDING A SINGLE JIG LID and a vise jaw, the new Universal Combination Vise can serve equally well for both milling and drilling operations, enabling up to 60 percent cut in the usual overall cost. Locked and unlocked by a single stroke of the arm, this vise is precision made for accurate, easy operation. Get new descriptive literature from DOWNING ENGINEERING CO., Dept. 64, 4005 Smithville Rd., Dayton, Ohio, or use INFORM-A-GRAM Key No. K64-V.

COMBINING AIR GAUGING WITH HYDRAULIC POWER CONTROLS, the new Monarch Type "B" Air-Tracer turning machine is so sensitive that contours of mandrels, punches, dies, spinning chucks, valves, etc., respond within a limit of tenths. All details about this new machine, along with the story of lathes during the past 30 years, case histories of special jobs handled by Monarch machines, and unique Monarch methods are reviewed in the well-illustrated booklet "Turn-O-Gram, No. 6," now obtainable from MONARCH MACHINE TOOL CO., Dept. 5-38, Sidney 1, Ohio, or use INFORM-A-GRAM Key No. 538-V.

DEEP HOLE DRILLING OF OIL HOLES in Diesel engine connecting rods performed on the new Barnes horizontal drilling machine is described in Performance Data Sheet No. 15. By the use of two spindles, two connecting rods are gun drilled with 5/8" oil holes through their length, every 18 minutes. This No. 420 Horizontal Drilling Machine is built in various sizes of 4-foot, 8-foot, 10-foot and 12-foot stroke. Copies of this performance data sheet are available upon request from the W. F. & JOHN BARNES CO., Dept. 80, 345 S. Water St., Rockford, Ill., or use INFORM-A-GRAM Key No. 80-V.

ALWAYS FREE FROM WARPING, rust, and bumps, Rahn Black Granite Surface Plates guarantee to .00005" surface accuracy and assure smooth action in moving instruments. Eliminating costly errors and production delays, these surface plates come in "Regular" and "Super" styles. They are fully explained in illustrated literature with price list now available on request from RAHN GRANITE SURFACE PLATE CO., Dept. 63, 1149 Platt Circle, Dayton 7, Ohio, or use INFORM-A-GRAM Key No. K63-V.

A COMPLETE LIST OF STANDARD STOCK TOOLS made of high grade speed steel, with deductible discounts for various amounts of purchases, is given in a new folder issued by David A. Coleman & Co. A dimension table of metal slitting saws, milling cutters and end-mills, tool bits, gear cutters and other tools is shown. Write to DAVID A. COLEMAN & CO., Dept. 58, 5908 W. Chicago Ave., Chicago 51, Ill., or use INFORM-A-GRAM Key No. K58-V.

SEEING WITH SAFETY with eye protection products made by Surty Mfg. Co. Shields for the machine made of super-bonded glass in various sizes are ideal for precision grinding or where worker has deficient sight. See-Saf plastic windows also give complete protection, can be fashioned to size and shaped to suit special jobs. Complete information is available upon request from THE SURTY MFG. CO., INC., Dept. 57, 4141 W. Kinzie St., Chicago 24, Ill., or use INFORM-A-GRAM Key No. K57-V.

FOR HIGH PRECISION ON A HIGH PRODUCTION BASIS the Norton Company has four C-type cylindrical grinders to meet various requirements. The 4" type C machine, available in 12" and 18" lengths, for small work up to 2" in diameter; 6" type C for small center type operations in small or large quantities; 10" type C excellent for work such as large shafts and various engine parts; and the large 14" and 16" type C grinders. For full specifications write to NORTON CO., Dept. 5-45, Worcester, Mass., or use INFORM-A-GRAM Key No. 545-V.

HIGH PRODUCTION CENTER DRILLING MACHINE is described and illustrated in a two-color four-page bulletin, DCD-1, issued by Detroit Tap and Tool Co. Single lever control for complete centering operation, automatic positioning, clamping, and releasing mechanisms are discussed in detail. Illustrations and specifications are included. Write for bulletin DCD-1 on company letterhead to DETROIT TAP AND TOOL CO., Dept. 1-34, 8432 Butler Ave., Detroit 11, Mich., or use INFORM-A-GRAM Key No. 134-V.

"KEEP YOUR OIL CLEAN" is the subject of a new four-page, two-color pamphlet describing Greer Hydraulics, Inc. full line of micronic filters. Importance of oil cleanliness and the hazards of contaminated oil are discussed. For a free copy of this descriptive pamphlet, write on company letterhead to GREER HYDRAULICS, INC., Dept. 55, 454 Eighteenth St., Brooklyn 15, N. Y., or use INFORM-A-GRAM Key No. K55-V.

A NEW RANGE OF SOLDERING APPLICATIONS for aluminum work, recently announced by All-State Welding Alloys Co., allows a still lower-temperature rub-on solder to be applied without flux. Alloy "All-State No. 39" aluminum solder rod is excellent for repairing cracks in aluminum cylinder heads and for filling in surface defects where high temperatures must be avoided. Address inquiries to ALL-STATE WELDING ALLOYS CO., INC., Dept. 56, 96 West Post Rd., White Plains, N. Y., or use INFORM-A-GRAM Key No. K56-V.

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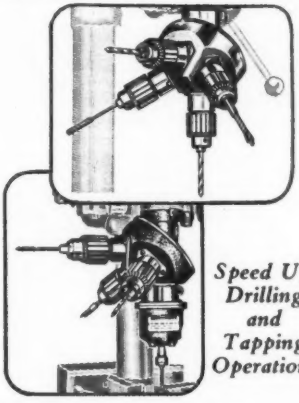

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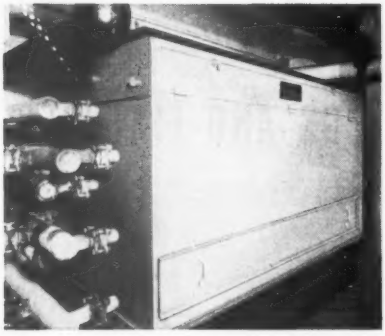

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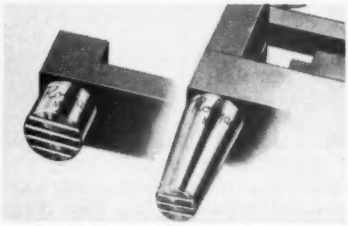

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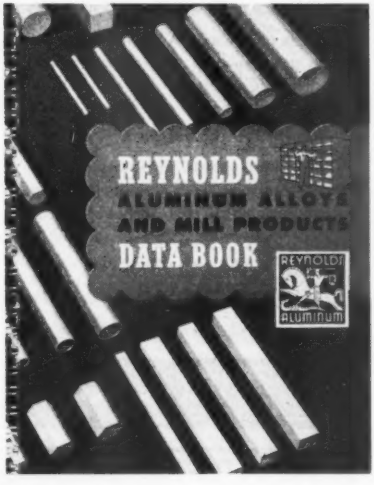
THE TREMENDOUS DEMAND FOR TECHNICAL INFORMATION ON ALUMINUM ALLOYS has prompted the Reynolds Metals Company to publish a 248-page book featuring 106 tables of technical data. A brief history of aluminum is followed by discussions on: alloy tempers; physical properties in which detailed data is presented on chemical, physical and mechanical properties of high purity aluminum; and nominal chemical compositions, typical mechanical properties, values of density of coefficients of expansion, thermal and electrical conductivity, annealing and heat-treating cycles for wrought, sand casting, permanent-mold casting, and die-casting alloys. Thirteen sections make up the book with a novel scheme of color indexing mill products into: sheet and plate, and extruded shapes; roll formed shapes; tubing and pipe; wire; rod and bar; forging stock; ingot metal; and press forgings. Copies of this book may be ordered direct from Reynolds Metals Co., Dept. 47, 2563 South Third St., Louisville 1, Ky., at $2.00 each or further information may be obtained from the company or by using our INFORM-A-GRAM Key No. K64-V.



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INFORMATION ON STAINLESS STEEL has been compiled by the Crucible Steel Co. of America and is now available in folder form, titled "Characteristics of Rezistal Stainless Steel." The data is tabulated under the headings of: trade name; physical properties; electrical properties; heat treatment; average mechanical properties; heat resistance; hardness; and working. These headings are broken down into sub-headings to cover all the characteristics of Crucible's stainless steel. Copies of this folder will be sent on request from the Crucible Steel Company of America, Dept. 2-56, 405 Lexington Ave., New York 17, N. Y., or use INFORM-A-GRAM Key No. 256-V.

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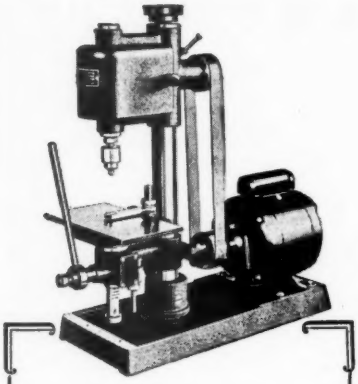

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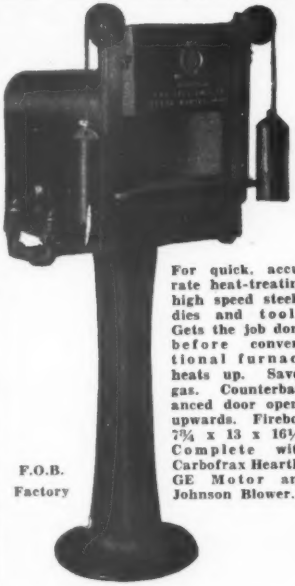

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(CONTINUED FROM PAGE 77)

Another group of materials has been developed, which while not plaster, may have a useful place. These are the flexible pattern materials. These occur in two main groups, i. e., castable flexible plastics and castable alginates. In each case the purpose is to produce a pattern by casting which is stable enough so that plaster may be cast around it and yet flexible enough so that the pattern may be withdrawn when the plaster has set. The reason for the development of such a material is obvious. With such a material, a part may be molded without regard to draft. However, in the present state of development, these materials leave much to be desired, especially if thin sections are to be cast.

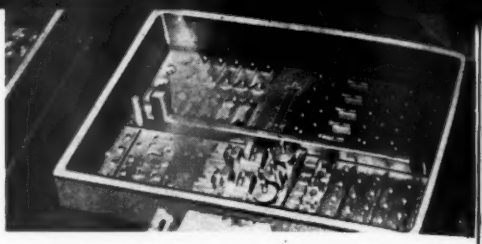


Fig. 30. The most advanced practices in plaster molding, metal casting in plaster molds, are employed in the precision casting of aluminum and bronze. Here the surface of a metal master pattern is being spray treated preparatory to the pouring of the plaster mix.

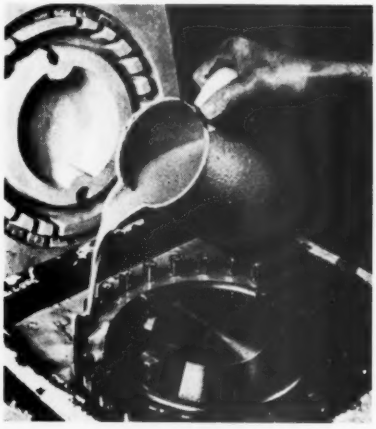


Fig. 31. Pouring the plaster mix and a completed plaster mold. To facilitate parting the plaster from the pattern and to insure that the final casting has a good finish, the surface finish of the metal master pattery must be of very high quality.

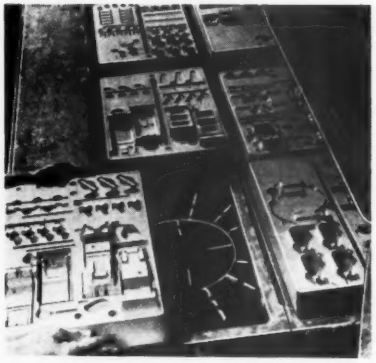
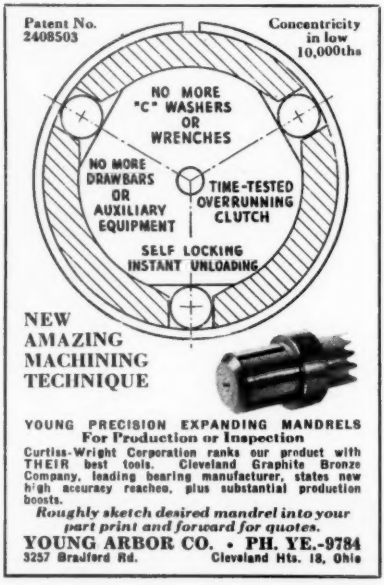


Fig. 32. Completed plaster molds. The process must be carefully timed and manipulated from the mixing of the dry plaster ingredients to the removal of the mold from the calcining furnace.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In summarizing this brief outline of plaster molding, it may be said that with present materials and carefully developed techniques, a large variety of such precision castings are already being made which have replaced other methods of manufacture at considerable savings. Due to the development of low density metal casting plasters, plaster molds may now economically compete with sand casting particularly where the sand casting must be machined.

The greatest handicap to the present process is in the long curing time and non-reusability of the plaster. However, work is being done to decrease the curing time from hours to minutes with plastic binders and also to make possible a reprocessing of the plaster for use over again.

Due to the low cost of the tools involved and the true precision which may be achieved, this process is ideal where shape and configuration do not permit die casting and where a limited number of experimental or developmental parts are needed.

As new materials are made available an increasing number of production applications will be found for this method.

Fig. 33. Positioning cores in a plaster mold. As in older foundry practices, the use of cores in plaster molds serves to control internal shapes, lessens the weight of the cast product and reduces to a minimum the amount of metal removed in any final machining operations.

Combined Methods

Although each individual precision casting method offers merits which can be of value to the automotive industry, a combination of two or more of these

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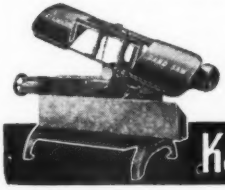

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Fig. 34. The final operation of pouring or casting the metal in the plaster molds. The tilt of the mold during the pouring assists the gravity flow of the metal to the furthermost portions of the cavity.

can frequently be of optimum utility.

Particularly is this so when the production advantages of the die casting or permanent mold casting method can be combined with the design advantages inherent in the investment or plaster molding method.

Such combinations found widespread use during the war in the manufacture of superchargers, both shrouded and plain, and similar parts for the aircraft industry. In general, the method is to make a die or permanent mold and insert a ceramic or plaster core after which the cast is made in the conventional manner, casting either statically, centrifugally or under pressure.

With some designs it is difficult or impossible to make the plaster core in one piece due to back draft in which case the core may be broken down into castable units and assembled into the permanent mold. In the past, sand has been used for the core material but it did not permit the desired dimensional tolerances or give the casting surface finish required. The use of plaster cores in permanent molds offers a large field in precision casting.

Conclusion

Many of the developments and appli-

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cations discussed in this paper are not new in the art of metal casting, but comparatively recent improvements in materials and techniques have opened up new fields of application which if properly utilized can be of considerable value to the automotive industry. In particular is it felt that the increased freedom in design and selection of materials made possible thereby will be helpful in developing tomorrow's cars.

Acknowledgment:

The authors wish to express their appreciation to the following individuals and firms for valuable suggestions and material used in preparing this paper: Dr. E. T. Valyi of the A.R.D. Corp., Mr. F. W. Burgie of the Doehler-Jarvis Corp., the Haynes Stellite Co., the International Nickel Co., the Bohn Aluminum Co., and the Briggs Manufacturing Co.

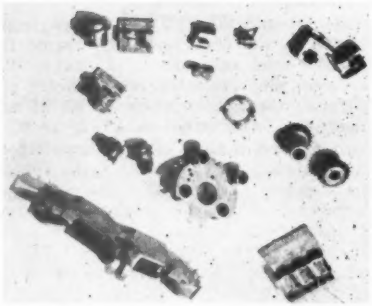

Fig. 35. A typical representation of the variety of bronze and aluminum precision parts that are being produced by metal casting in plaster molds.

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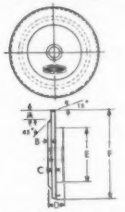

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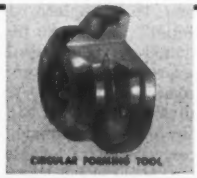
00-50	00	3/16	.0975	1/16	.050	1/4	1 19/64	1.750	4.00
00-60	00	1/4	.131	1/16	.060	1/4	1 19/64	1.750	4.00
00-80	00	3/8	.1985	1/16	.080	1/4	1 15/16	1.750	4.00
0-60	0	3/8	.1935	3/32	.060	5/16	1 3/8	2.250	4.50
0-80	0	1/2	.261	3/32	.080	5/16	1 3/8	2.250	4.50
0-90	0	5/8	.3363	3/32	.090	5/16	1 3/8	2.250	4.50
2-60	2	3/8	.1935	1/8	.060	3/8	2 7/32	3.000	5.60
2-90	2	5/8	.3265	1/8	.090	3/8	2 7/32	3.000	5.60
2-125	2	1	.5234	3/32	.125	3/8	1 29/32	3.000	5.60
2-156	2	1	.5318	3/32	.156	3/8	1 29/32	3.000	5.60



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(CONTINUED FROM PAGE 84)

counterbores a smaller diameter hole in which stem washer M, Figure 24, is inserted in the final assembly, reams the 23/64" hole, and puts a 12° angle surface on the bottom of the bonnet. The form of the bonnet at the finish of this operation is indicated at C, Figure 27.

After retraction of the counterbore and indexing of the spindles, the spindle in number three position has moved to number four position where an internal thread is cut in the bonnet with a tap installed in the main tool-slide. This is shown at D, Figure 27. The operation in the fifth position employs a countersink set up in the main tool-slide to remove the burrs from the preceding tapping operation E, Figure 27. The final operation in this cycle is the cutting off of the bonnet from the bar stock by a cut-off tool mounted on the cross-slide in the sixth position F, Figure 27.

When this machine is in full production the operations on the individual spindles just described are taking place on the six spindles simultaneously, so that each time the spindles index, a piece is completed.

As the bonnet workpiece is cut off from the bar stock, it drops about four inches into a metal chute. It was found that this drop nicked and marred the finished surfaces, and to avoid this damage, the Parker automatic screw machine supervisor installed a leather pad in the chute to cushion the fall of the parts.

Broaching

The second stage in the production of the bonnet is broaching a portion of the OD to a hex shape which provides a wrench grip for assembling purposes. This is done on an American Broach & Machine Company power broach shown in Figure 28. Two opposite surfaces are cut at one pass of the broach, which is known as straddle broaching. Therefore, three passes of the broach are required to complete the hex. The sketch in Figure 29 illustrates these three steps.

It requires a third set of machining operations to complete the bonnet. These are performed on the Goss & DeLeeuw automatic chucking machine, the functioning of which has been described in previous parts of this

(CONTINUED ON PAGE 138)

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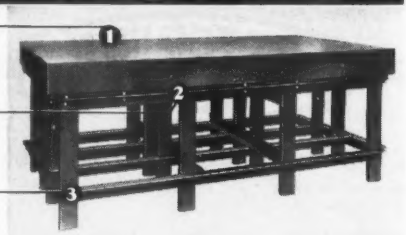

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Admission to the exposition will be by invitation. For the convenience of visitors, advance registration will be arranged by the Association through their offices at 10525 Carnegie Avenue, Cleveland 6, Ohio.

During the nine-day Show the doors will be open from 10:00 a.m. to 5:00 p.m. There will be evening technical sessions of the Machine Tool Congress at various Chicago hotels, headquarters for participating organizations.

Directors of the NMTBA are Messrs. Herbert H. Pease, Alexander G. Bryant, Lloyd D. McDonald, Louis Polk, Harry W. Bockhoff, Albert M. Johnson, William L. Dolle, Fred W. McIntyre, and Herbert L. Tigges.

The members of the Machine Tool Show Committee are Messrs. Swan E. Bergstrom, chairman; William L. Dolle, R. W. Glasner, Helge G. Hoglund, Ralph J. Kraut, and Louis Polk.

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(CONTINUED FROM PAGE 136)

article. Rough and finish counterboring, finish turning and external threading are the operations in this cycle.

The two counterboring operations shape the upper interior of the bonnet to accommodate the packing N, Figure 24. These two counterbores are set up in the first and second spindles of the Goss chucking machine and produce the shapes shown in A and B, Figure 30, respectively. A box mill is mounted in the third spindle for finish turning the top OD of the bonnet to the external thread diameter C, Figure 30, and this external threading on the top of the bonnet is performed by a self-opening die at the fourth spindle position D, Figure 30.

To insure the concentricity of the counterbore and external threads with the internal threads of the bonnet, threaded adapters are set up in the Goss chucks to hold the bonnet during the counterboring and external threading operations. The bonnet is run on the threaded portion of the adapter by the operator at the loading station.

(TO BE CONTINUED)

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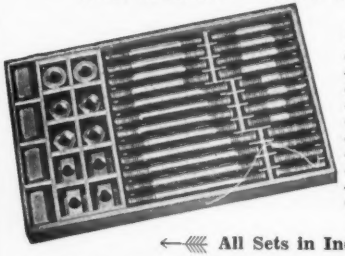

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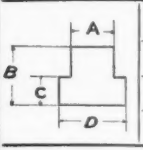

Holes & Thread	A	B	C	D
½"—13 THD.	.555	¾"	11/32"	⅜"
⅝"—11 THD.	.675	1⅛"	15/32"	1⅛"
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Formerly, the four alloys were aged at two different time periods: 14S and R301 were aged together at 350° for six hours, while 53S and 61S were aged together at 350° for eight hours. Rush jobs were delayed due to the time difference which necessitated either delaying the 14S and R301 six-hour treatment while the furnace was being used to age 53S and 61S for eight hours, or else using the engine mount furnace, rivet furnace or wood shop furnace for heat treating.

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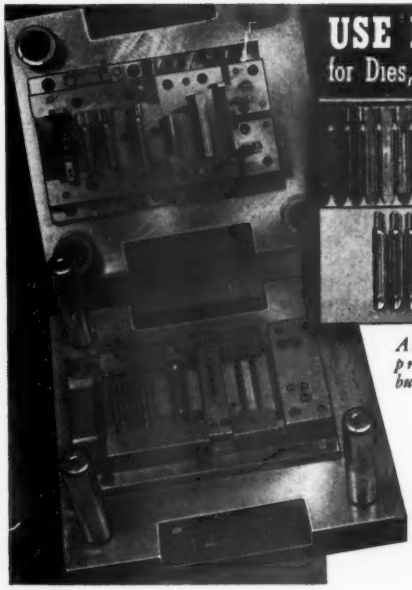

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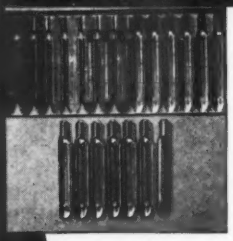

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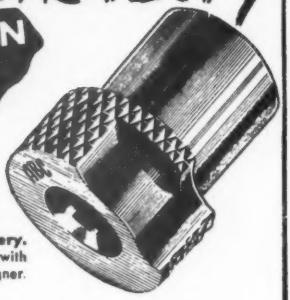

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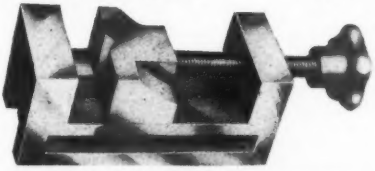

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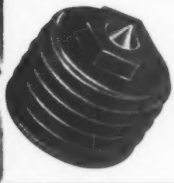

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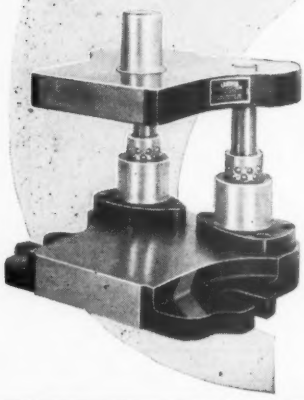

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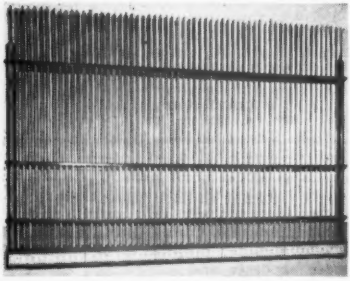

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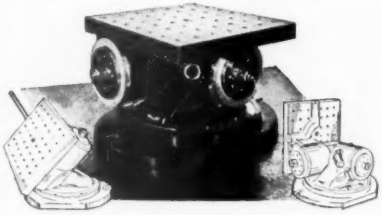

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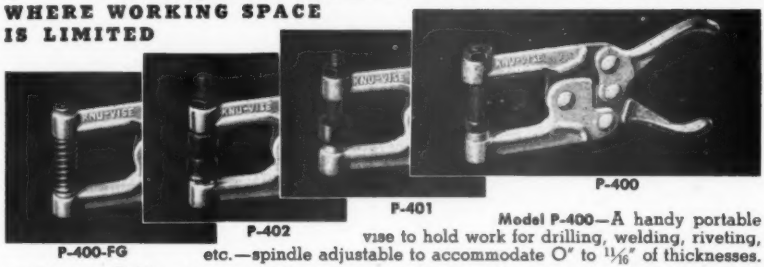

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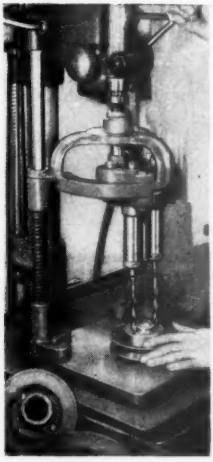

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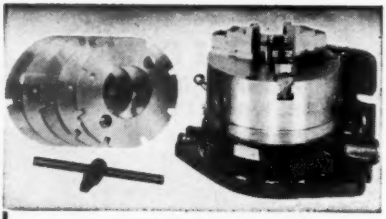

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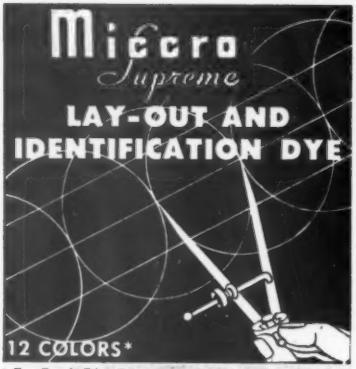

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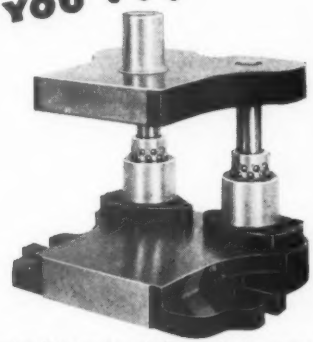

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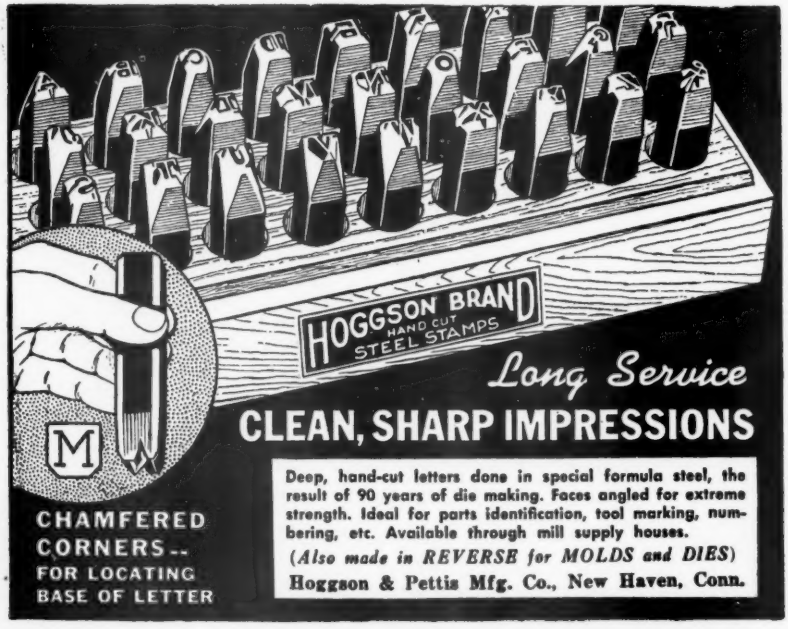

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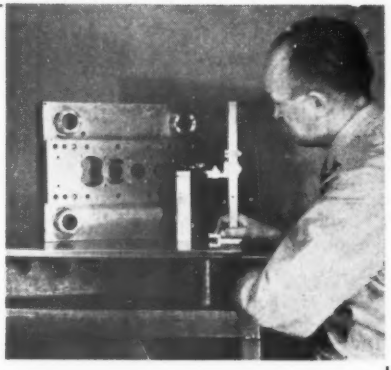

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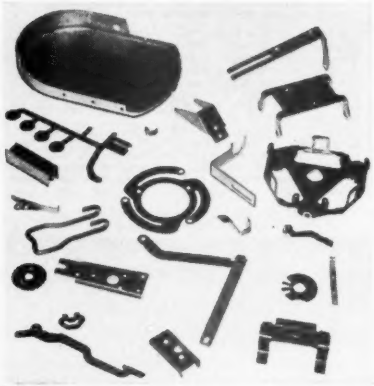

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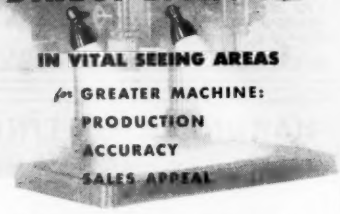

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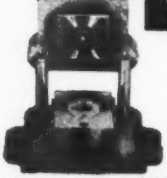

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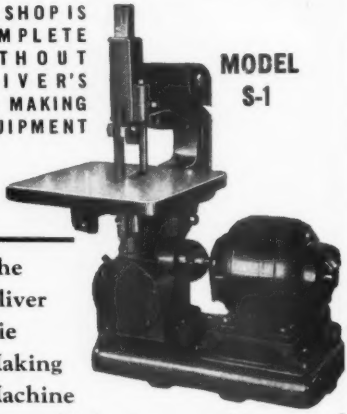

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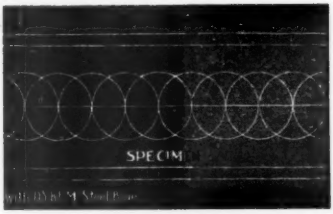

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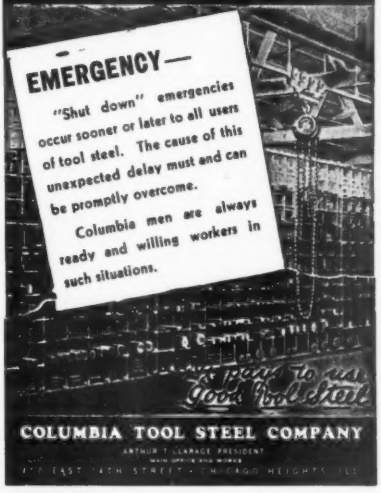
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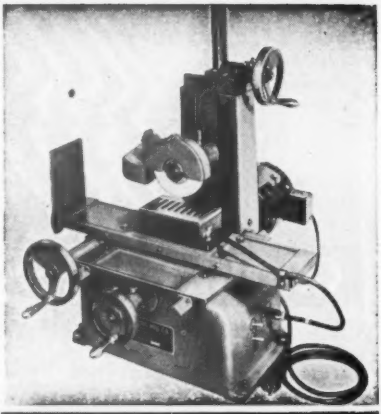

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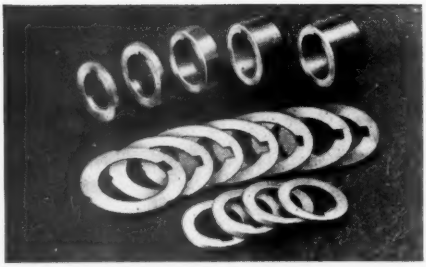

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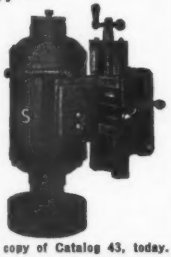

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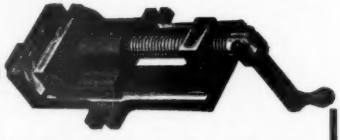

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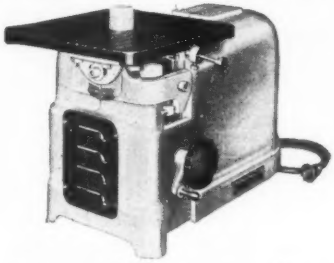

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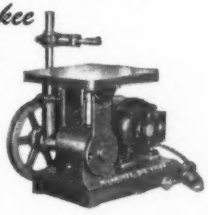

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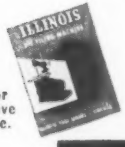

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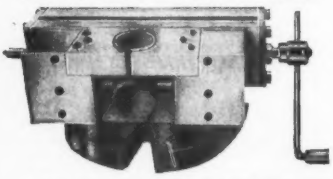

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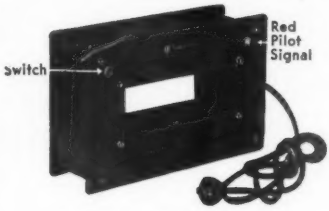

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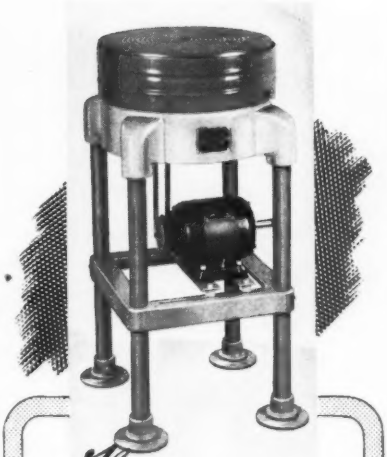

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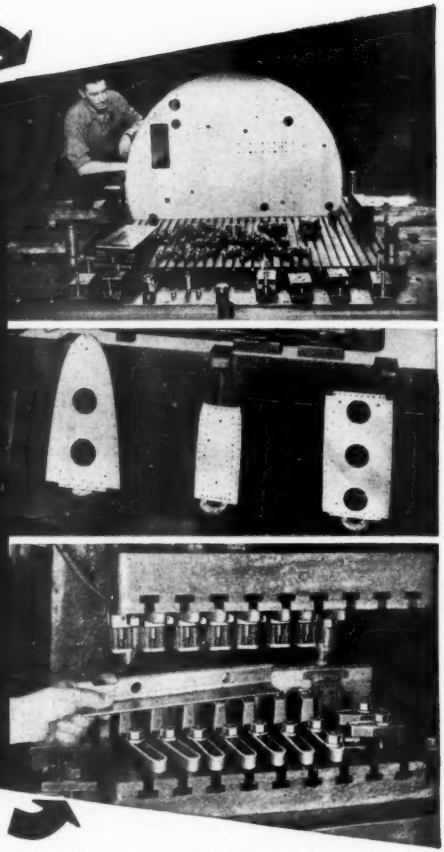

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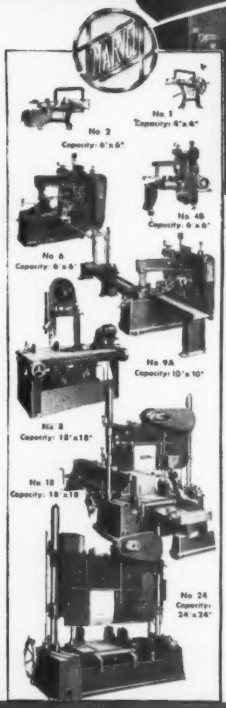

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